# MANPOWER FORECASTING AND EDUCATIONAL POLICY



Report and studies



Ontario

Commission on Post-Secondary Education in Ontario

Available from
The Ontario Government Bookstore,
880 Bay Street,
Toronto, Ontario.

Price $5.00

Published by
the Queen's Printer,
W. Kinmond, Toronto
1972

Design Bruce M. Rapp Associates, Toronto

# MANPOWER FORECASTING AND EDUCATIONAL POLICY

A Study Prepared for the Commission on Post-Secondary Education in Ontario

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## Editorial Foreword

The Commission's terms of reference required it to consider the pattern necessary to ensure the effective development of post-secondary education in Ontario during the period to 1980, and in general terms to 1990. Among the specific considerations referred to in the terms of reference was the charge to study and make recommendations on "the educational and the cultural needs of students to be met at the post-secondary level in Ontario, including adult and continuing education" and "the patterns of student preference and demand in post-secondary education, especially as they are influenced by social and economic factors. . . ." Even more specifically the Commission was asked to examine and make recommendations concerning the "number of students for whom provision should be made in various types of institutions and programs. . . ." It appears self-evident that the pattern of student preference and demand in post-secondary education is in some important way influenced by the kind and quantity of job opportunities for which post-secondary education has come to be regarded as a prerequisite.

In the course of its deliberations the Commission has subjected the relationship between education and employment to close and critical scrutiny. One aspect of this, the use of educational attainments to screen or sort people as to occupational eligibility—the certification function—has been examined in a separate background study, ***Certification,*** and is the subject of direct comment and recommendations in the Commission's ***Draft Report.*** The other aspect, the "manpower issue" is the subject of the present volume.

In a hypothetical perfect market economy, that part of the demand for places in post-secondary educational institutions generated by occupational considerations could be expected to be regulated automatically by the changing responses of individual students to their perception of their best personal interest in relation to known employment prospects. But, in the real world, the necessary conditions for effecting such an automatic matching of employment opportunities and appropriately qualified graduates appear difficult to achieve. The evidence for this is taken to be the observed "shortages" of certain kinds of graduates or the "surplus" of such graduates. Given time, these shortages or surpluses might well be expected to be self-correcting as individuals responded to their knowledge of such circumstances through their individual decisions as to their own best courses of action. But the social costs of such an automatic adjustment mechanism may be judged to be excessive, even if it could be shown to be operative.

Consequently, public policy measures have been recommended to provide the desired matching of graduates with employment opportunities more smoothly and at less cost both to society and to the unfortunate individuals who have to bear the brunt of such adjustments through facing unemployment. Such policies may attempt to operate either on the demand side of the market for highly qualified manpower—that is, by attempting to influence the number and the kinds of job opportunities available—or, on the supply side, by influencing the numbers of highly qualified candidates produced for such positions. Either approach, but most certainly the second, would appear to necessitate major public interventions affecting the size and operation of our post-secondary educational institutions, at least insofar as they are engaged in preparing people for the labour market.

Because of this, as the Commission noted in its ***Statement of Issues,*** education is often regarded as an instrument of manpower planning. At the same time we also noted that the experience to date with manpower planning suggests that it is a

notoriously unreliable instrument of public policy, perhaps in part because of technical difficulties inherent in such exercises, but also possibly because of the difficulty of establishing, as we said there, "any but the most tenuous links between educational requirements and future manpower needs." (***See*** Commission on Post-Secondary Education in Ontario, ***Statement of Issues,*** page 6).

In order to assemble the information pertinent to these problems, and also to provide a critical focus for subsequent discussion of them, the Commission determined in the spring of 1971 to sponsor a background study on the subject of manpower planning in relation to educational policy. At the same time, it had become apparent that whatever the limitations of such planning might on further examination prove to be, it would be immediately helpful to the Commission to have available the best possible manpower and enrolment projections obtainable for Ontario. The Commission consequently invited qualified parties to submit tenders on a composite study of manpower planning techniques combined with a practical exercise in the application of such techniques. The specific objectives of this study were to evaluate past and present manpower planning techniques, to assess their relevance to educational planning and, in the light of this analysis, to make projections of the demand for and the supply of highly qualified manpower in Ontario to 1990. Although this latter exercise was to utilize as much as possible the work already done by various government and other agencies in the field, it was also expected to provide a practical demonstration of the "state of the art" of manpower and enrolment projections, including a survey of the utility of "flow modelling" techniques in such applications.

A contract was awarded for this work on a competitive tendering basis to Professor John W. Holland of the Ontario Institute for Studies in Education early in June, 1971. Professor Holland led an expert and most industrious team consisting of M. L. Skolnik, S. Quazi, and M. F. Siddiqui in producing the study published here. The study was submitted to the Commission in August, 1971.

Part A of the study analyzes the extent to which it is desirable and feasible to base post-secondary educational planning on projections of manpower requirements. The findings of this section are summarized and discussed in Chapter VII. Part B consists of an exercise in producing a set of qualified manpower requirement projections for Ontario through 1990, followed by a set of post-secondary educational enrolment projections for the same period. An attempt has been made in this section to provide as much of the background data as possible in the form of summary tables, but considerations of space have necessitated the deletion of large amounts of detail. This excluded material is available to interested researchers from the Commission or the Department of Colleges and Universities; copies of it have also been placed in selected library depositories.

Several sections of this study deal with topics that are the subject of direct reference and recommendations made in the Commission's ***Draft Report.*** Some also touch upon matters which are the subject of other reports in this series of published background studies. Among the latter, the reader's attention is drawn in particular to the ***Cost and Benefit Study of Post-Secondary Education in the Province of Ontario for the School Year 1968-69,*** and also to the study on ***Financing Post-Secondary Education.***

The opinions and conclusions contained in the present study are solely those of the authors, and publication of this study does not necessarily mean that all or any of these opinions and conclusions are endorsed by the Commission.

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A Report Prepared for the
Commission on
Post-Secondary Education in Ontario

by

J. Holland, S. Quazi, F. Siddiqui, and M. Skolnik

August, 1971

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## ACKNOWLEDGMENTS

The following people have been especially helpful in providing data and advice. The authors wish to thank them for their assistance:

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   Chief, Employment Surveys Section,
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2. Mrs. A. Kempster,
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# INTRODUCTION

This study was motivated by the current need for clarification of the possible contributions of manpower forecasting to better educational planning. More specifically, the authors have attempted to demonstrate the present state of the art of manpower forecasting and of its complement, post-secondary enrolment forecasting. An effort has been made to explain the relationship of these aspects of public policy research to prevailing conditions in Ontario, and to offer some guidelines for post-secondary educational policy and continued policy research. Concern for the level of educational expenditures and for current rates of unemployment, particularly of university graduates and other members of our highly qualified labour force, are explicitly acknowledged as components of the political climate contributing to an increasing interest in manpower forecasting as an important part of, if not the basis of, educational planning. At the same time, however, a sincere effort has been made to give as much attention to the relevance of manpower forecasting to the longer-run goals of post-secondary education in Ontario as to manpower forecasting and temporary political exigencies.

Part A of the study analyzes the conditions under which the linking of educational policy to manpower projections

might contribute to general welfare, and the specific mechanisms through which manpower studies may be exploited for educational policy-making. Analysis of these questions involves examining the characteristics of the market for highly educated manpower and the factors influencing the decisions of students, employers, employees, professional associations, and educational policy-makers.

Part B is an essay on manpower projection and enrolment projection methodologies plus reports on two projection studies. The first is a projection of provincial manpower requirements through 1990; the second is a projection of post-secondary enrolment for the same period. The projection of manpower requirements, besides demonstrating the methodologies of manpower projections, indicates the vulnerability of projection results to inadequate data and incomplete understanding of the processes of substitution among different kinds of labour. In the authors' opinion, the inadequacies of the data upon which these manpower projections are based make any attempts to derive policy recommendations from them inadvisable. To avoid even the appearance of such recommendations--and because the manpower projection data is incommensurate with the enrolment projection data--the authors eschew any comparisons between the requirements projections in Chapter I of Part B and the enrolment projections in Chapter II of Part B. Such comparisons must await substantial

improvements in the data base and in the understanding of the processes of labour substitution and inter-occupational mobility.

While the authors have serious reservations about these and any other projections of manpower requirements, they present the enrolment projections with more confidence. Here the projections are based on data of reasonable quality and a projection methodology of proven accuracy. The university enrolment projections in this report were produced in a manner similar to the Watson and Quazi (1968) projections. The latter projections have proved to be the most accurate of alternative projections of university enrolment for the period 1968 through 1971, being generally within one per cent of the actual figure. While the authors believe the enrolment projections in this report to be about as sound as the earlier Watson-Quazi projections, it is well to point out that the level of future post-secondary enrolment is determined in large part by the future behaviour of educational policy-makers. The projections in this report assume that there will not be major changes in that behaviour, e.g. remarkable increases in or elimination of fees or financial assistance to college or university students. The possible impact of such changes on graduate enrolment are explored briefly, however, emphasizing the sensitivity of enrolment projections to policy.

Unfortunately, enrolment forecasts in which one might express considerable confidence, at least over the first 5 to 10 years, are disappointing guides to the answering of major policy questions without complementary manpower requirements forecasts of comparable quality. In summary, it must be conceded that the analysis of the relationship between manpower forecasting and educational policy-making and the evaluation of the current state of manpower forecasting raise a number of questions and answer few. Nevertheless, on the basis of these studies some conclusions or policy guidelines do appear justified.

Those who would hope for policy recommendations in certain terms and quantitative prescriptions will be disappointed. The more modest policy guidelines that follow do seem warranted on the basis of the work reported here. They consist of a few positive suggestions, some negative conclusions, and somewhat more specific recommendations for further research.

1. It should be accepted that there is considerable potential at this time for exploiting manpower studies in the improvement of educational policy. However, the recent international history of manpower forecasting does not suggest that mechanistic long-term projection studies based on census data (for example, replications today of studies in the OECD Mediterranean Regional Project, even though they were very appropriate undertakings in their time) are worth the associated costs.

It can be said with more certainty that neither the logical nor statistical bases of such projects justify their use in determining the number of places of various types to provide in post-secondary education.

2. It should be assumed that there is considerable flexibility in the pattern of responses of decision-makers to changes in manpower requirements. Most of the evidence, though limited, suggests that, when not constrained by restrictive organizations, legislation, etc., students, workers, employers and even, in most cases, educational institutions are quite responsive to pecuniary incentives in making decisions which determine the supply of and demand for educated manpower.

3. A jurisdiction should take care that it is not a party to producing the constraints that are responsible for the inflexibilities in its educational system and labour market for which it must resort to educational-manpower planning to overcome. Particularly, it should be noted that two factors when operating in combination seem to be very potent inhibitors of flexibility in the labour market. Those two factors are long formal education requirements and strong professional associations or unions. In most instances, where only one of these factors is at work, perceived shortages and surpluses are notably ameliorated in a few years. When the two factors are both at work, perceived shortages appear to be capable of indefinite duration. Moreover, the state, by allowing its

schools to become legitimate screening agents at the service of the professional associations, is contributing to the perpetuation of inhibitors to the mobilization of new specialists in response to perceived high wages in the particular field.

In this regard it is appropriate to note that the popularly perceived shortages of Ph.D.s in the 1960s did not survive the decade; a comparable shortage of M.D.s is still a fact of life in Ontario and the rest of North America after 30 years.

4. It should be emphasized by students of public policy to policy-makers that long-term manpower forecasts, even far better ones than we are now capable of producing, will not correct the inflexibilities in the labour markets and education resulting from the combination of long formal education requirements and strong professional associations.

The best approach to dealing with entry barriers will vary for different occupations. Depending upon the circumstances, it may be appropriate to revise legislation exempting professional associations from anti-monopoly prohibitions. Contributing to countervailing power through the encouragement of consumer associations may also prove appropriate. In at least some cases, strengthening of university senates by legislation aimed at reducing the power of professional organizations over professional schools would be very effective. In still other cases, state control over licensing, propri-

etary practice regulations and membership in local association chapters should be very effective.

5. In order to deal with "bottlenecks" in the mobilization of highly skilled labour, i.e. areas where rate of returns to further educational or training investment are likely to be very high, at least in the short run, manpower studies of specific occupational fields are likely to yield very satisfying results. Such studies might help to indicate the causes of the bottlenecks and the most appropriate types of remedial action. In those cases where studies suggest that the reduction of entry barriers is not likely to eliminate persistent excessively high or low earnings, the government may attempt to influence supply through direct control mechanisms. These manpower studies should focus on the determinants of labour supply and demand, i.e. the responsiveness of students, workers and employees to changes in wages, and the institutional inhibitors at work. Emphasis in these studies should be on providing historical and current annual data on numbers employed, average earnings, earnings of recent entrants, and when possible, numbers in training for those occupations.

Such manpower studies are not, of course, manpower projections in any sense.

6. Studies attempting to relate gross provincial or national product to manpower requirements should not receive support as projects likely to improve public policy in the foreseeable

future. Not only do such studies become the raw material of lobbyists for professional associations (particularly the members of those associations with interests in the education of new members), it is not at all clear whose behaviour should be affected by the findings. In a society such as Ontario or Canada, with educational investment decisions made at so many different locations of authority, and particularly by millions of individuals, it is probably only appropriate to speak of manpower shortages or surpluses in terms of "high" or "low" earnings, or better still, changes in earnings, and current employment prospects.

7. Finally, it should be emphasized that the social demand approach to educational planning, particularly when accompanied by government efforts to eliminate restrictive practices and continuing efforts to produce up-to-date and reliable information on earnings and employment prospects, is neither an unsophisticated approach to policy improvement nor "non-planning".

It is unfortunately true that the social demand approach to the provision of education does not help us to determine how much to spend on public post-secondary education (or any of its components). This remains a political decision. It can only be said that the jurisdiction concerned should spend on education up to the point where it is a matter of indifference whether another dollar is spent on post-secondary education or

left in the taxpayers' pockets. When that point is reached before all qualified applicants are accommodated, it is appropriate and feasible to increase the share of educational costs being borne by the students.

At the very least, however, this frank recognition of the provision of post-secondary education as the satisfaction of a public want should not make the question of how much to spend on this service any more difficult to answer than the other approaches. If a rate of returns, benefit cost, or manpower requirements approach is used, it must first be decided how much to spend in accord with the optimum solution of the specified objective function, and then how much to spend, if anything, in serving the social demand for education not already provided. No matter how expert we become in producing education budgets in accord with one of those objective functions, it will not help us to answer the second question, nor will it eliminate the need for dealing with that question.

# PART A

## CONCEPTUAL PROBLEMS IN RELATING EDUCATIONAL POLICY TO MANPOWER PROJECTIONS

# CHAPTER I

## A STATEMENT OF INTENTIONS AND CONDITIONS

The intention of all that follows in this report is to clarify the extent to which it is socially desirable and technically feasible to take projections of manpower requirements into consideration in formulating educational policy. It is hoped some contribution can be made both to the general questions regarding manpower studies and educational policy-making and to the more particular questions regarding manpower and education in Ontario.

It is conceded that manpower requirements and manpower policy objectives might conceivably be used to construct valid criteria for educational policy pertaining to secondary schools and even to elementary schools. It is more emphatically conceded that policy-making for any level of education can be a rational process only if policy for other levels is regarded as a constraint, or if it can be assumed that policy-making for one level will motivate sympathetic policy adjustments by policy-makers at other levels. Nevertheless, the concern expressed here is for manpower and post-secondary educational policy-making almost exclusively. Which is to say, of course, that the authors recognize the total educational system of Ontario as not being notably inflexible and consider the over-lapping educational bureaucracies as capable of serving simultaneously objectives emanating from more than one location of authority.

The present concern--to the authors of this report, to politicians and public administrators in Ontario, and to the articulate Ontario public--for linking educational and manpower policy is due in large measure to the harsh fact that in this well-endowed province many people are now unemployed. Unemployment rates that most of us consider distressing if not intolerable have persisted for more than two years and are not expected to be notably ameliorated in the very near future. This situation prevails in spite of the fact that we have made great sacrifices over the last decade, through public fiscal allocations, to increase educational opportunities. As a result we have had a great expansion in what both our social scientists and journalists refer to as our stock of human capital or highly qualified manpower. Well into the second half of the sixties, our propensity to increase spending on public education at a remarkable rate, whether by comparison with other jurisdictions or with our earlier spending behaviour, was receiving favourable endorsements both in learned articles and newspaper editorials as sound investment calculated to contribute to our prosperity, an equitable distribution of income, and full employment.

In the last two years evidence has mounted, and finally become overwhelming that, at least as a political verdict, we are overspending on education. Apparently, we have passed the point where it is a matter of indifference whether or not a small increase is made in public spending on education,

accompanied by a small decrease in after-tax income of our citizens. Less apparently, we may also have passed the point where it is a matter of indifference to Ontario tax-payers whether or not a small increase is made in public spending on education accompanied by a small decrease in public spending on other "nice things" provided by the public sector.

There is no widespread conviction among the people of Ontario that unemployment rates would be higher if we had spent less for education, or if we had increased educational expenditures less rapidly in the decade recently closed. The work force of Ontario is "more educated" than ever before, but this is true of the unemployed members of the work force as well as the employed. Moreover, the very expensively educated constitute a very vocal and visible component of the unemployed work force.

Under these conditions, it is as unthinkable that there would not be both a popular clamour for, and a scholarly interest in, "a manpower policy" as it would be that the concern for price stability in recent years were not accompanied by a popular and scholarly interest in a "wages and prices policy".

The demand for "a manpower policy" and for "a wages and prices policy" both reflect a rather profound dissatisfaction with the approaches to, tools for, and results of stabilization policy in Canada. Further, to speak of _a_ manpower or _a_ wages

and prices policy, as if there were no such policies at present, implies not only a demand for stabilization policy adjustments not yet made, but also a new or different orientation to stabilization policy.

"A manpower policy" can imply many different approaches to government interference with the market or, more accurately, with the countless choices of individuals, institutions, and government agencies that collectively determine the level and pattern of educational expenditures in a jurisdiction. Right now, in Ontario, when individuals or the press speak of "a manpower policy"--particularly when they speak of "a high-level manpower policy"--what is usually meant is a post-secondary educational policy based on estimates of the present and projections of the future demands for and supplies of qualified labour. At another time the connotations of manpower policy might be very different.

Once we concede the connections between manpower-based education policy and the objective of full employment, it becomes painfully clear that definitive normative statements for that policy in Ontario, or anywhere else in Canada, are not possible, given the state-of-the-art (or the prevailing conventions) of the economics of public finance and our constitutional arrangements.

In regard to the inadequacies of public finance as a theoretical frame of reference, it is enough merely to remind ourselves that, in conformity with the conceptualizations of

Richard Musgrave (1959), it is customary in North America today to base normative explanations of stabilization policy on the assumption of the separation of fiscal policy authority into three independent departments: one responsible for allocation policy, one for distribution policy, and one for stabilization policy. No government in the world is so organized as to allow the perfect separation of allocation, distribution, and stabilizing fiscal decisions, of course. But in the real world--i.e., in the governments we know--stabilization adjustment decisions can be isolated to some degree from allocation and distribution decisions. Policy-makers are more or less free to specialize, at least momentarily, upon a single set of objectives. When provincial or institutional policy-makers for post-secondary education are pressured to serve stabilization objectives however, we certainly have one of the "less free" cases. So long as these authorities are expected to assume total responsibility for efficient allocation of resources to and within our system of post-secondary education plus partial responsibility for one aspect of our stabilization policy, we are at a loss for even the most abstract model of ideal behaviour on their part.

In regard to our constitutional arrangements as an insurmountable barrier to the construction of a normative model for serving the objective of full-employment via a manpower-based educational policy, three important and closely linked facts of life must be emphasized. The first two regard the old and

popular theme of provincial-federal relations. Ontario has exclusive responsibility for education in this province. The national government has an almost equally perfect monopoly on the conventional tools of (employment and prices) stabilization policy. The third is an assumption associated with the available descriptions of ideal stabilization policy, that such policy can affect economic decisions throughout an entire economy. Alternatively, we can say such models assume a closed economy.

Ontario is too poor an approximation of a closed economy to allow us to suppose that a provincial manpower-educational policy can fulfil the employment objectives of stabilization policy. In addition, a fair approximation of perfection in stabilization policy, using currently feasible policy tools, would require the co-ordination of manpower and wages-and-prices strategies. There does not exist in this nation any organizational machinery for co-ordinating manpower policies of the provinces or the efforts of provincial and federal authorities in designing and implementing stabilization policy.

The fact that there is no hope at this time for the design of a model of a perfect manpower-educational policy is not, however, an argument against sustained efforts to exploit manpower studies in the improvement of educational policies. There is, after all, room for a great deal of improvement this side of perfection. But the lack of an abstract model of perfection in this policy area does increase the probability

of confusion as to the criteria to apply in critiquing manpower-educational policies. This, in turn, is a situation which suggests that the different approaches to melding manpower and educational policy will continue to be associated with political polemic, and choices among them determined in large measure by ideological orientations.

# CHAPTER II

## THE MANPOWER AND POLITICAL CONTENT OF EDUCATIONAL POLICY

### A. Educational Policy

One reason--perhaps the main reason--why it is very difficult to initiate a fruitful dialogue on the returns to educational efforts is that schools have so many different uses that the parties to the dialogue are seldom contemplating the same ones at the same time. For several thousand years men have been discovering new uses for schools in the struggle to make other men behave in a tolerable fashion. The uses of this ingenious device for the regulation of human behaviour are apparently infinite. As appreciation for this utility grows, so does "school policy" as an aspect of politics.

It is not likely that there will ever be unanimity among the constituents of any polity on a value hierarchy for school uses. A school that in the eyes of some men is doing the Lord's work with dispatch will always be an instrument of the Devil in the eyes of other men. Still others will see it as impotent and a sinkhole for resources needed elsewhere. In consideration of the diversity of opinions on what schools do, this discussion of educational policy will begin with a few of the uses which men have found for schools that seem to bear particularly on the problems of making urban life worthwhile. Because the subject matter of this project is post-secondary education, the uses of those institutions will be emphasized.

A dominant theme in western history of the last five hundred years has been urbanization, or more accurately, the rearrangement of urban institutions to accommodate the increasing and concentrating population. Traditionally, all the western nations have turned to schools as a device for defining and maintaining existing distinctions among the several classifications of urban citizens. In the urban situation, with its physical mingling of classes and its interclass activities and communication media, important distinctions among the classes--such as speech, cultural interests and formal employment qualifications--would be extremely difficult to maintain without customizing formal education to urban classes.

The German gymnasiums, the French lycées, and the grammar schools of England restricted entry to those who demonstrated a mastery of the skills that characterized middle-class youths, notably linguistic skills. In turn, success in these institutions was rewarded with a good opportunity for the most secure of middle-class positions, a place in the civil service or a place in a university leading to the learned professions. Access to such schools was jealously defended against encroachments by new elements of the middle class. For this reason, access, when it could be attained by a new or aspiring member of the middle class, was assurance that the new status would be permanent.

These classical European secondary schools overlap educational levels referred to as secondary and post-secondary

education in North America. Moreover, as high school has become part of the common school experience in Ontario and many other North American jurisdictions, post-secondary education here, through undergraduate school, has become a closer counterpart to the classical secondary schools than our high schools are. It is now the quantity and quality of post-secondary education that are the important determinants of a youth's chances of attaining and holding secure middle-class adult status.

There is little point in describing post-secondary education as either a medium or a barrier to social mobility, since it is both of these things. What is very important is that it be given its due as an important mechanism for the control of social mobility. The continuing process of human relocation that is urbanization requires such efficient mechanisms for the distribution and assurance of status in society.

The function performed by schools of any level in establishing and maintaining a social structure need not involve government at all. It can be left to the interaction of individuals, performing separately, in households and in institutions. However, once a government decides that the identity of self-interest and common good is not applicable in education, a need for government interference in this activity area exists. If in any jurisdiction there is a discernible pattern in this interference, or if any statements of objectives to be served by such interference exist, then there is an educational policy in that state.

All theoretical arguments to the effect that public education is a good thing, worth imposing on the taxpayers, must start with this assumption of inadequacy in the identity of public and private interests. Such theoretical arguments are the stuff from which educational policy is derived.

But even if the control of the distribution of social status in an urbanizing society is an important function of education--and one that justifies government interference or an educational policy--it is only one use or function of education in such societies.

Post-secondary educational operations are resorted to by people seeking to become wiser or at least better informed. They are attended by people seeking to learn what is necessary, and undergo other preparations necessary, to enter particular trades and professions. People attend them to increase their probability of establishing certain personal relationships with other people from fairly specific classifications. These relations include, of course, marriage, friendship and employment. Post-secondary institutions also attract people seeking legitimate and acceptable alternatives to work and marriage. And, of course, schools are just plainly a place to be.

People teach in or perform other work in post-secondary educational institutions because they are paid to do so and/or because they intend to have an influence on any or all

of the personal interactions that take place in those institutions. Providing them with these opportunities is another important function of post-secondary education.

Any one of these functions may be the source of activities concerning which the principle of identity of self-interest and common good does not apply. Therefore, they may invite public policy making.

No modern sociological description of a family, class, neighbourhood, community or ethnic group in contemporary Canada would omit an examination of the effects of post-secondary education, or its absence, in determining the life style and "life chances" of the people concerned. Seeley, Sim and Loosley (1956), in their study of the predominantly Jewish middle-class community of Forest Hill, for example, could scarcely have begun their descriptions of the values and activities of that community had they not resorted to the uses of post-secondary education, primarily university education. Not only is the university an institutional means of social mobility and economic success there, it is a powerful determinant of people's behaviour for years before and after they enter it, and even if they never attend it. Similarly, Porter, in The Vertical Mosaic (1965), could not have described the structure and salient characteristics of Canadian society in such meaningful terms to contemporary Canadians had he not been able to resort to the relationships among post-secondary education, individual and group social status, and the distribution of economic power.

The institutional complex that is post-secondary education would not be so effective in determining the structure of social relationships and the terms of interaction among classes of people in modern urban or urbanizing societies, if it did not consist of specialized institutions. For better or worse, different types of institutions draw their students from different social strata and turn them out with different social and economic "chances". In the cities of Europe, where the modern concept and social reality of the middle class originated, the classical secondary schools were complemented in time by less prestigious institutions, often called middle schools, which offered status protection and opportunity to lower middle-class and upwardly mobile working-class youths that the former offered to middle-class youths. Today, in Ontario and in many other jurisdictions, universities are complemented by a variety of less prestigious post-secondary institutions. The universities offer the status protection and opportunity to middle-class and would-be middle-class youths that classical secondary schools once offered. The less prestigious post-secondary institutions offer status protection and opportunity to lower middle-class and working-class youths that the middle schools once offered. In Ontario, the Colleges of Applied Arts and Technology are the most important complement to the universities in our post-secondary system. The relative roles of

these two types of institutions in apportioning social and economic chances among the population may or may not be determined without government interference aimed specifically at influencing those relative roles. A decision by government to interfere in some specific way, or not to interfere, in this development, is an excellent example of educational policy. If government never addresses itself to this development, it can be said there is no policy regarding it.

The report of the Provincial Committee on Aims and Objectives of Education in the Schools of Ontario, Living and Learning (1968), leaves its reader with little doubt that a large and influential portion of the Ontario public and the education establishment believe that the time has come for a great many policy adjustments regarding education in this province. At least some of the recommendations of that committee might better be described as calling for policy reforms rather than policy adjustments. Certainly the recommendations to the effect that the distinctive levels within the public educational system--particularly those of elementary and secondary school--be eliminated or modified along with the accompanying testing or selection points (pp. 180-186) are of this nature. As is often the case with formal policy reform recommendations, these call for reforms that are already being implemented in parts of the system.

If what is indeed emerging in Ontario is a public school system, through secondary school at least, that de-emphasizes

both the traditional selection processes at specified points of passage through the system and the visible institutional organization related to those selections, this may be described as tailoring policy to accommodate the reality of mass secondary education and constantly rising educational expectations. It constitutes a challenge to post-secondary educational policy-makers. They have little choice but to deal via policy with these questions. To what degree will the kinds of social and academic selection once performed by secondary schools and the passage from elementary to secondary school now be performed by post-secondary schools and the passage from secondary to post-secondary institutions? To what degree will the post-secondary system also reorganize to accommodate mass participation and rising expectations?

Normative answers to questions of educational policy or objectives are the results of a deductive process in which the major inputs are individual concepts of good government and personal opinions about the distribution of virtue and talent in the population. A high degree of consensus on normative questions, or questions of what ought educational policy objectives to be, is not enough to prevent educational policy-making from being a source of disharmony in a society. The parties to the political process which is educational policy-making must also be in general agreement on the sociological questions of educational policy: How things got to be the way they are? Why things develop as they do?

Two parties might agree that the province should spend on post-secondary education up to, and only up to, the point where educational expenditure is matched by increased productivity in the population equal in value to that expenditure. They might also agree that the province far exceeds that level of expenditure. But if they do not agree on how that condition came about, they will likely not agree on the appropriate policy adjustment. The first might believe the present expenditure level exists because of the cupidity of teachers and the effective lobbying of teachers' organizations and educational politicians, and that their frustration is a price worth incurring to increase the after-tax income of the citizenry. The second might believe this expenditure level exists because youths in each cohort in our society have been taught that they should obtain more schooling than did their fathers, and have been led to expect educational opportunities greater than those which the cohort before them met. He may believe, also, that to fail to meet those expectations will have a dangerously demoralizing effect on youths and their parents, and that a tax saving at that price is not worth having.

In any case, it is to be expected that educational policy-making will not be the source of bitterness and political dissension only when it is being made by authorities whose sense of proprieties is unquestioned. This, in turn, can only be expected when the franchised members of the community affected by that policy have common values and a very similar

view of the world. Such may well have been the case when a duly elected group of respected men of property made educational policy for small and stable jurisdictions in this province. It was perhaps the case when a prestigious group of Christian gentlemen on a board of governors made policy for a small sectarian university. It is not expected to be the case when educational policy-making is an important component of statecraft at municipal, provincial, and national levels. Further, it is not to be expected that consensus about educational policy pertaining to economic objectives will be had with any more ease than consensus on either the non-economic objectives or the proper hierarchy of economic and non-economic objectives.

B. Manpower Policy

Just as all the very important functions of schools may suggest any amount of government intervention to promote the common good, so might the activities of the labour market be subject to any amount of government intervention. The important business of mobilizing manpower might be left to the outcomes of decisions made by people acting individually or through institutions. Both the business of moving labour from the household to the market and the business of allocating that labour among the competing activities of our economy may or may not be viewed as matters for policy-making and implementation at any or all levels of government.

However, we have become used to the situation of governments acting to influence the decisions of individuals and institutions regarding education and employment, and would be hard put to say what is worthwhile for governments to do in promoting the commonweal if they were not to interest themselves in the regulation of these activities.

On the one hand, the activities of government to control the labour market will overlap with government activities to influence the behaviour of educational systems. On the other hand, they will overlap all the activities connected with other aspects of public economic policy. It is not easy, therefore, to separate perfectly the functions and objectives of manpower policy. Indeed, what is considered the subject matter of manpower policy at one time or in one jurisdiction may well be considered the domain of educational policy, or economic growth, stabilization, or distribution policy at another time or in another place.

Nevertheless, it is safe to say that in North America today the purpose of manpower policy is to cope with currently perceived imperfections in the labour market. More specifically, the functions of manpower policy are:

a) to avoid bottlenecks due to shortages of particular skills;
b) to avoid surpluses of trained manpower;
c) to reduce the time lags in adjustment of labour supplies and demands;

d) to insure that individuals are working at jobs where their talents are fully utilized.[1]

(In subsequent chapters, these functions will be referred to as the objectives of manpower policy.)

1. Policy tools and approaches

All of the above mentioned functions of manpower policy, singly or in various combinations, are or have been translated into manpower programs serving more or less specific objectives. In manpower policy, like some other policy areas, it is very difficult to move from statements of goals or purposes to legitimate functions and then to meaningful operational objectives.

In the case of manpower policy, as with educational policy, the objectives, if achieved at all, are the results of influences emanating from many sources, and the effects of these are very difficult to fix and measure. The policy tools available are fairly crude instruments, not comparable to those in fields characterized by artisans with intuitive understanding of their materials or technicians with proven theoretical foundations.

These policy tools are numerous and include public employment exchanges, counselling and testing programs,

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[1] These are almost the same as the general functions of manpower policy stipulated by E. Wright Bakke in his frequently quoted treatise, "An Integrated Manpower Policy," in Employment Policy and the Labour Market (1967).

retraining, accelerated upgrading and refresher courses, mobility assistance, employer liaison services, etc. "The heart of manpower policy is on the supply side" (Magnum, 1965: 241) and, appropriately, these tools are primarily for working on the supply aspect of labour market deficiencies. In particular, manpower policy has concentrated on changing people's qualifications, attitudes, location, and the information available to them. In addition it has been conventional in this nation for manpower policy to concentrate on members of the labour force who have left the educational systems and are at least 25 years old. If nothing else, this convention has been very useful on those occasions when for political, constitutional or other reasons it is necessary to distinguish between educational activities and "manpower" activities.

It is fair to say that in Canada manpower policies, both national and provincial, have been intended to effect marginal adjustments on the fringes of "the system", the system in this case being a great complex of institutions and activities including the labour market and the educational system. There have been frustrations associated with such modesty in the approaches to manpower policy.

2. Alternative approaches

There are those who argue that manpower policy should be more concerned with the demand side. No doubt a surplus of engineers could be mitigated by government(s) allowing such

a surplus to determine expenditure patterns. For example, elaborate research centres might be set up to deal with pollution problems, centres which would not, or not yet, have been set up if the government expenditures were determined by more conventional allocation criteria. Such a strategy differs from the more common policy suggestion of stimulating aggregate demand through fiscal and monetary policy in that it emphasizes selectivity. In this sense, such policy is very similar to that behind programs of regional industrial incentives.

As yet, no government-sponsored projects have had the improved employment prospects of scientists or engineers as an explicit objective. Suggestions to the effect that the educational system be expanded as an activity to absorb the surplus highly qualified manpower it produces are not likely to carry, but they are an example of policy aimed at the demand side of the labour market with some particularly interesting and frightening aspects (Rowntree, 1968).

Another approach to broadening the scope of manpower policy is to give manpower policy makers more effective control over or influence upon the educational systems, particularly the post-secondary systems. E. Wright Bakke is only one of many who have felt compelled to repeat in recent years the refurbished adage that education is too important to be left to educators. In one of the most widely quoted treatises on manpower policy, he notes that traditionally education

has been the responsibility of educational authorities, but "increasingly . . . the knowledge, skill, and adaptability requirements for solving the problems of industrial stability and growth . . . have brought to light inadequacies in that traditional allocation of responsibility" (Bakke, 1965: 366)

3. Accepting an alternative

Bakke maintains that manpower policy makers must have considerable control over the educational system. There is some evidence, however, that educational administrators, policy makers and critics are becoming manpower policy planners. A perusal of such Ontario documents as Post-Secondary Education in Ontario, 1962-70 (Report of the Presidents of the Universities of Ontario to the Advisory Committee on University Affairs, May 1962) and "Report of the Select Committee on Manpower Training" (Ontario Legislature, 1963) raises the question of which way the takeover, if any, may go.

What seems certain is that the outputs of the post-secondary educational system will be recognized as a proper policy variable to determine the market conditions faced by highly qualified manpower. The degree to which those conditions will be controlled and who will control them is less certain. The great expansion of post-secondary education in the 1960s in Ontario has closed the gap in educational opportunity that once separated this province from other,

rich, industrialized jurisdictions on this continent.[2] An important motivation for expansion is thereby extinguished. This, plus changing moods about educational expenditure, suggests that future expansions of the educational system will need to be based on convincing arguments of direct linkages between expansion and economic requirements. Certainly, recent statements by provincial politicians and influential educational officials suggest that this type of generalization about the political climate is not out of order.[3]

This could, conceivably, result in an educational policy based on manpower requirements. Social and political aspects of life and education in Canada are likely to counter

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[2] Z. E. Zsigmond and C. J. Wenaas make the point that the closing of the gap between the U.S. and Canada regarding secondary schools is now history (Enrolment in Educational Institutions by Province, Staff Study No. 25, Economic Council of Canada, 1970, 36-38). They also note that the gaps in post-secondary enrolments between the U.S. and Canada are closing (37-38), and demonstrate that Ontario is not unlike other industrial provinces in regard to post-secondary opportunities. Enrolment and expenditures comparison between Ontario and specific industrialized states of the U.S. can be made by comparing annual provincial statistics with those of the National Education Association and the U.S. Office of Education. Rankings from such comparisons do, of course, defy satisfying interpretations.

[3] A very clear example of this sort of statement was offered by former Deputy Education Minister of Ontario, Dr. J. R. McCarthy, in his address at the Conference on "Financing Public Education in Ontario: Analysing Choices for Effective Planning," Constellation Hotel, Toronto, May 31, 1971: ". . . the increased amounts would have to be justified on the basis of economic growth, the demands and needs for other services in the fields of health, unemployment relief, welfare and the like."

any very extreme movement in that direction, however. The cooling ardour in several OECD countries that have previously relied heavily on manpower planning as the basis of educational policy (See, for example, Direction de la Documentation, France, 1971: 41-42.) should also serve to dampen the enthusiasm for manpower-educational planning current in Ontario.

C. The Political Environment

During the 1950s it began to appear that Japan and the industrialized nations of Western Europe would be more effective in serving full employment as a policy goal than would the United States and Canada. During the 1960s all doubts of this were resolved. In the 1970s the full implications of this North American failure are being learned, while the decision as to whether or not it will be tolerated is being made.

Certainly Canada and the United States have some very difficult problems that the other industrialized nations of the west do not. Some are common to the two, some peculiar to one or the other. For example, the United States is the only one of these nations experiencing the traumatic adjustment caused by the urbanization of black farm workers, and Canada is the only one of these nations not only allowing but inviting hundreds of thousands of immigrants. Moreover, it is the U.S. dollar that is the fundamental instrument of

international exchange, and the Canadian economy whose terms of trade are most determined by the relative value of the U.S. dollar.

On the other hand, several other nations overcame the conceptual and political problems of a full-employment policy while coping with situations at least as difficult as those now plaguing either the United States or Canada: Japan, while absorbing the new members of its labour force that are a product of the days when the nation was known for its fecundity rather than effective contraception and abortion; West Germany, while absorbing the refugees from the east; and Italy, while struggling with the economic and social calamity that is its Mezzogiorno.

There are prerequisites to the effective serving of a policy objective. The most important is to prepare a population to pay the costs, since policy objectives, like other things worth having, do cost. All too often, full employment is bought at the expense of price stability. It may well be that price stability can be served via increased productivity, with or without full employment, but the fact remains that a policy objective of full employment is associated with sacrifice of price stability, and at the very least, a nation must be prepared to use price stability as a control variable when serving full employment as a policy objective. Certainly such preparedness has characterized the nations that have been

more successful than this one with "full employment" policies (Gordon, 1967). There is as yet no such preparedness in Canada.

The high rates of unemployment that characterize Canada in "good years" would be intolerable in Western Europe or Japan of the last decade. Our unemployment rates in "bad years" would be considered evidence of staggering policy failure. One result of this is that we are reduced here to using manpower planning for a monumental task to which it is not adequate--at least, to which it is not adequate in a society without the will and mechanisms for planning output in all sectors, if not all industries and firms. In that case, of course, though manpower planning might be necessary or desirable, it would not be required to deal with unemployment.

Fiscal and monetary approaches to a full employment policy will likely prove to be effective at some point in the future in reducing the fluctuations in unemployment we call cyclical. These are changes that take place too rapidly to be associated in our minds with fundamental technological or social developments. Certainly the time required both to set up manpower programs and to put people through them make these efforts ineffective in dealing with this kind of unemployment. The sanguine assumption is frequently made that fiscal-monetary approaches will stabilize unemployment at some low rate, perhaps some rate approximating that associated with the

"good years" in our recent economic history. If this should be the case, manpower programs might well be the logical approach to dealing with the unemployed residual. Presumably, certain social and geographic characteristics associated with the people in this residual would facilitate mobilizing programs aimed at them. Even if unemployment stabilizes at some rate considerably higher, perhaps that associated with "average" rather than "good years", assuming the people affected still demonstrate particular social or geographic characteristics, manpower programs may be effective in dealing with the unemployed residual. Whatever unemployment rate we assume, however, it does not seem probable that this residual will include significant numbers of people with post-secondary education or prepared for post-secondary education immediately. To put it more carefully, post-secondary education will not likely be the cheapest or most effective way to make people in this residual employable. It is not probable, therefore, that our present concern for linking post-secondary educational policy and manpower planning to serve a full-employment policy will survive a Canadian commitment to the exploitation of fiscal and monetary policy to serve full employment.

D. Summary

When any jurisdiction makes the decision that the consequences of leaving educational decisions to individuals and institutions are unacceptable and begins to formulate

objectives or desired outcomes for their activities, educational policy is being made there. When that jurisdiction's legislators or bureaucrats have conceptualized the many educational activities within its boundaries, their interrelationships, their costs and contributions to the commonweal, and begin to practice (or even propose) consistent patterns of behaviour to minimize those costs or determine those contributions to the commonweal, it is possible to speak of the specific educational policies that characterize that jurisdiction.

Certainly the connections between statecraft and education are most obvious when the state promulgates laws for the teaching of morality, customs, or skills deemed necessary to good citizenship and the stability of the state. Educational policy is no less a component of statecraft when a jurisdiction interferes with the autonomous decisions of individuals and institutions to affect the distribution of wealth, status, and the other good things the society has to distribute among its members, or to promote the productivity of its citizens.

Educational policy exists also when the state consciously refrains from interfering with the autonomous decisions of individuals and institutions regarding an aspect of their educational activities or their educational activities in total. Frequently the "institutions" involved are agencies of the state itself, products of an earlier act of policy-

making. When, however, those agencies begin to affect people's lives differently from the way they originally did, or their effects are perceived differently, interference with their behaviour and decisions is as much the material for new policy-making as is interference with the behaviour of individuals and private institutions.

Manpower policy as a component of statecraft is neither older nor better established than educational policy. However, its recognition as a matter of prime concern for policy-makers at all levels of government spans about four decades in the Anglo-Saxon states, while educational policy has only been so recognized for a little more than one. Moreover, manpower policy may be regarded as a natural (i.e. not surprising) extension of the principles and traditions that are the basis of labour economics. More specifically, those traditions are associated with the concepts that labour is not just a commodity like any other, and that labour is more than a factor of production. Nevertheless, manpower policy exists as an important aspect of politics or statecraft for the same reasons as educational policy, an unwillingness to tolerate the perceived consequences of citizens acting individually, in combination, or in institutions.

Having said, in effect, that educational and manpower policies exist to compensate for or correct dissatisfaction with free educational systems and labour markets, and are

patterns of interference with those systems, it must be emphasized that nothing can be said in the abstract about the forms those interferences should take.

It is the political environment that is the source of operationally meaningful policies. It is a coincidence of our times that in Ontario, in the rest of Canada, and in the United States, the political environment is motivating policy suggestions that blur the distinctions between educational policies and manpower policies. That environment is characterized by disconcertingly high rates of unemployment affecting an unusually (in recent experience) wide range of the spectrum of qualified manpower, and conditions of international economic competition that inhibit the exploitation of fiscal and monetary policies in serving a policy of full employment.

# CHAPTER III

## MANPOWER PLANNING AND THE ACHIEVEMENT OF SOCIAL AND ECONOMIC OBJECTIVES

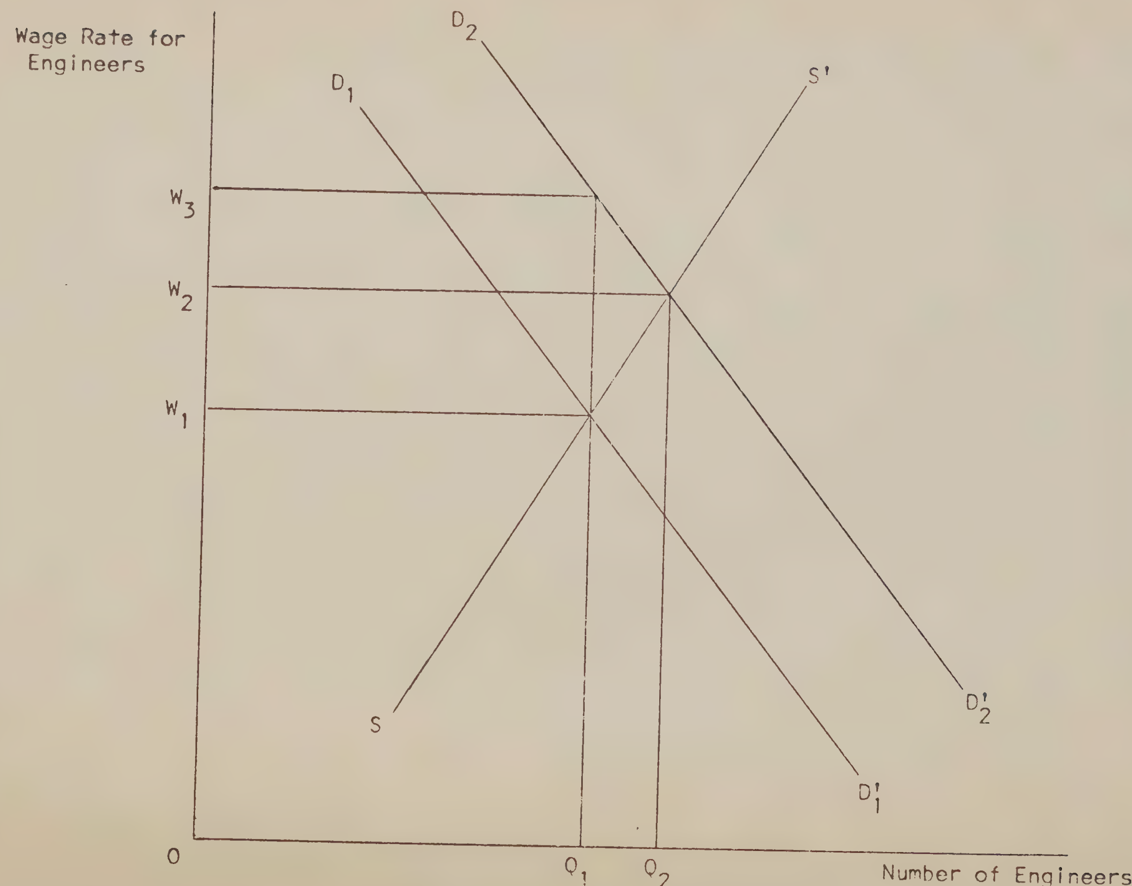
### A. The Case for a Manpower-based Education Policy

In the absence of nationally co-ordinated manpower planning, the supply of and demand for highly trained manpower are the outcomes of decisions by countless students, employers, and educational authorities. These decision-makers need not be reacting to the same motivations, information, institutional constraints, or assumptions about the behaviour of other participants in the economic system. The question arises as to whether the manpower objectives stipulated in Chapter II-B can be achieved in this situation. If not, at least a *prima facie* case can be established for integrating educational and manpower policies.

The intent of this chapter is to consider in more detail than previously the conditions under which the unco-ordinated career decisions of students, along with the likely responses by employers, will lead to the achievement of the manpower objectives specified in Chapter II-B. The case for a manpower-based education policy in Ontario depends upon the degree to which these conditions characterize this province. However, as will be noted in Section D, the evidence available is not adequate for assessing the prevalence of these conditions.

Figure III-1

The Demand for and Supply of Engineers



## B. The Workings of the Labour Market for Highly Trained Manpower: The Case of Engineers

In the following discussion, certain relevant points about the working of the labour market for engineers will be illustrated. This large and important category of highly qualified manpower has been the subject of considerable empirical investigation in Ontario in recent years (Gross, 1969; Committee of Presidents of Universities of Ontario, Ring of Iron, 1970).

### 1. Disturbing an equilibrium

Supply-and-demand functions for engineers, as conventionally drawn, assume that the number of people offering to work as engineers is positively related to the wage rate, and the number of engineers that employers are willing to hire is negatively related. These assumptions will be examined in the following sections. In Figure III-1, there is an initial equilibrium in the supply of and demand for engineers with $W_1$ as the wage rate for engineers and $Q_1$ as the number employed.

Suppose the equilibrium is disturbed by an increase in demand, due perhaps to a change in technology or consumption patterns. The new demand schedule is represented by $D_2D_2'$. The wage rate may be assumed to rise to $W_3$ in the short run. The increase in wage rate will induce an increase in the amount of qualified labour supplied if the supply schedule is

not vertical. In Figure III-1, the amount supplied is assumed to increase along SS' to $Q_2$ where a new equilibrium is established with the wage rate equal to $W_2$. The flatter the supply curve, the greater the increase in the amount supplied in response to a given increase in wages. The slope of the supply curve depends upon the responsiveness of suppliers to a change in wages.

2. <u>The supply response to an increase in the wage rate</u>

An increase in the wage rate for engineers should increase the expected financial returns for potential entrants to the occupation. The potential entrants can be divided into the following categories:

a) people in the labour force with engineering degrees or equivalent certification currently working in other occupations;
b) people with engineering degrees or equivalent certification not currently in the labour force or not currently employed;
c) people in the labour force working in positions subordinate to engineers, e.g. assistant engineers and technologists;
d) students who have just completed, or are about to complete, a program of training in engineering;
e) students enrolled in early or intermediate stages of courses in engineering;
f) students enrolled in post-secondary programs other than engineering;

f) secondary-school students.

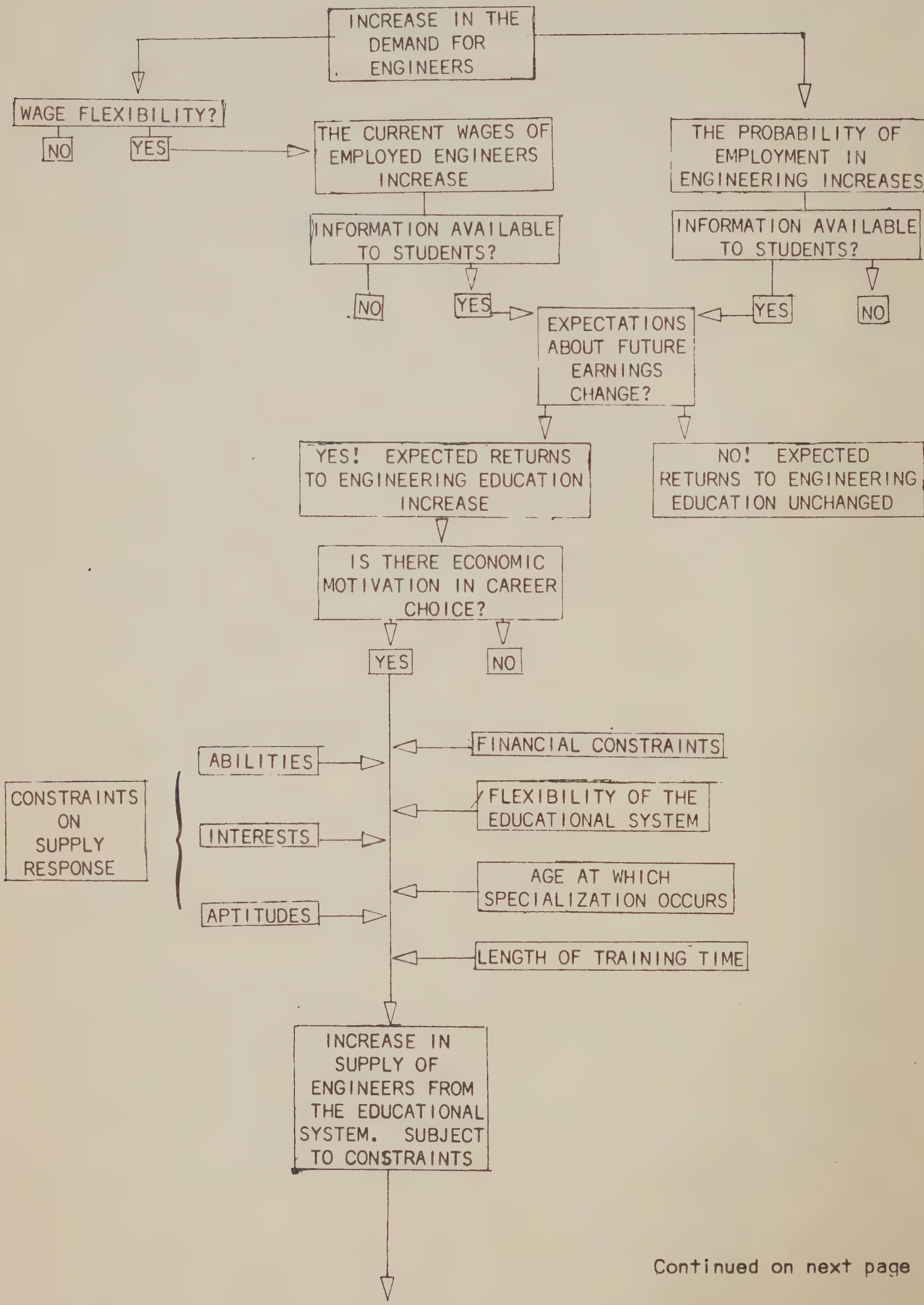
According to conventional economic theory, an increase in the returns that one expects from engineering will increase the likelihood that he will go into engineering. However, for a given increase in the returns expected from an engineering education, the increase in the probability of entering engineering may be very small. For a given wage increase the inducement to enter engineering will vary over the categories of potential entrants listed above, probably being strongest for those in category (d). The principal concern of this report, however, is with the response of those in categories (e), (f), and (g). As will be discussed below, the responses of other categories are important too, because a shortage may be filled from categories (a), (b), and (c) before students in the educational pipeline arrive on the labour market.

3. Behavioural effects of expected returns to engineering education

Consider the effect of an increase in the wages of engineers upon the expected returns to a degree in engineering. Assume then that students have information about the increase in wages, since changes in expectations about future wages depend upon perceptions of changes in current wages. Thus, in Figure III-2, information is specified as the second factor involved in the sequence of events which occur following the disturbance of the initial equilibrium. Now, how is

Figure III-2

Tracing the Effects of an Increase in the Demand for Engineers

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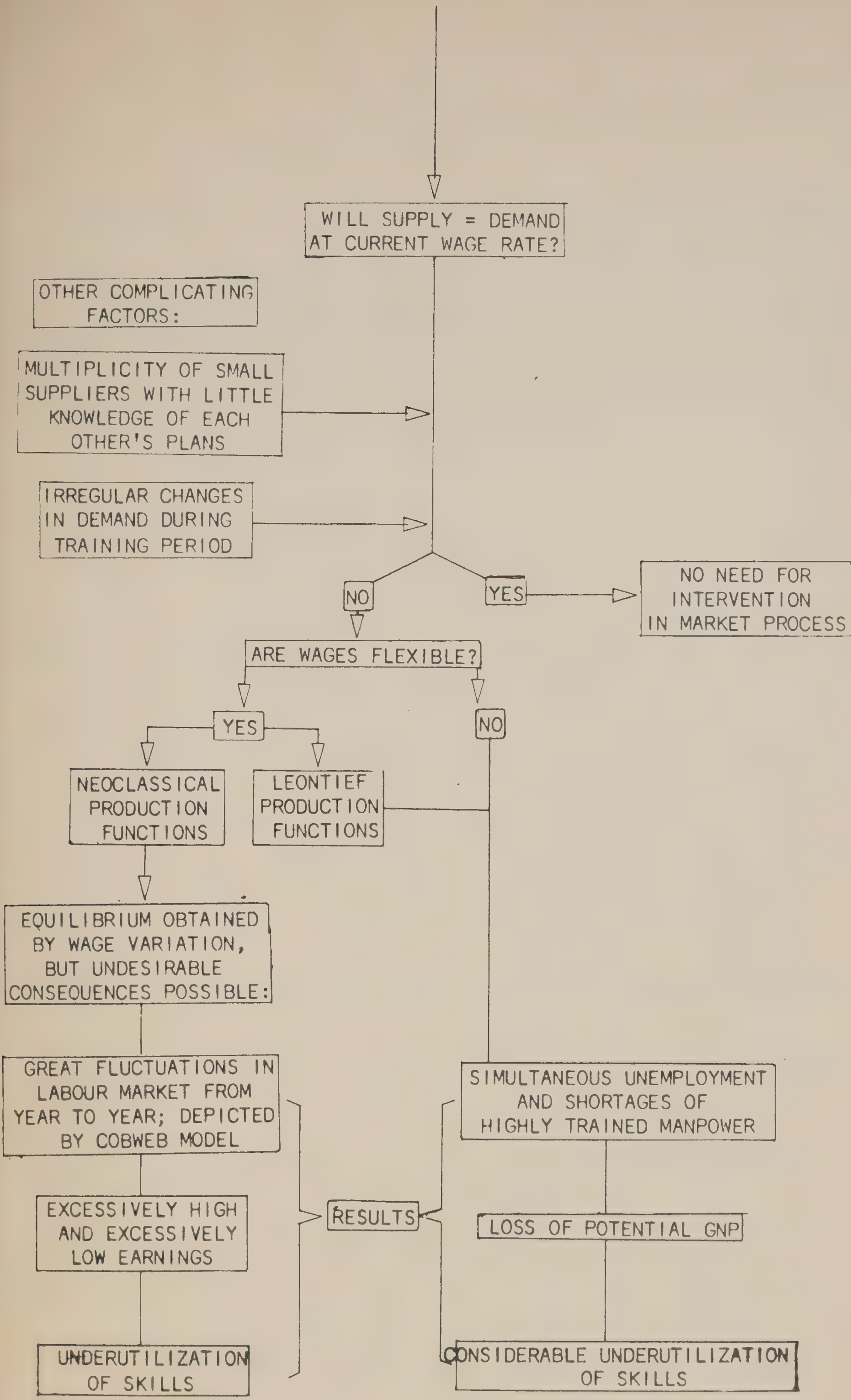

WILL SUPPLY = DEMAND AT CURRENT WAGE RATE?
OTHER COMPLICATING FACTORS:
MULTIPLICITY OF SMALL SUPPLIERS WITH LITTLE KNOWLEDGE OF EACH OTHER'S PLANS
IRREGULAR CHANGES IN DEMAND DURING TRAINING PERIOD
NO
YES
NO NEED FOR INTERVENTION IN MARKET PROCESS
ARE WAGES FLEXIBLE?
YES
NO
NEOCLASSICAL PRODUCTION FUNCTIONS
LEONTIEF PRODUCTION FUNCTIONS
EQUILIBRIUM OBTAINED BY WAGE VARIATION, BUT UNDESIRABLE CONSEQUENCES POSSIBLE:
GREAT FLUCTUATIONS IN LABOUR MARKET FROM YEAR TO YEAR; DEPICTED BY COBWEB MODEL
EXCESSIVELY HIGH AND EXCESSIVELY LOW EARNINGS
UNDERUTILIZATION OF SKILLS
RESULTS
SIMULTANEOUS UNEMPLOYMENT AND SHORTAGES OF HIGHLY TRAINED MANPOWER
LOSS OF POTENTIAL GNP
CONSIDERABLE UNDERUTILIZATION OF SKILLS

the information about the increase in current wages taken into account in forming expectations about future wages? Although economists have developed a variety of complex models of expectations (e.g. Bowman, 1958) they all assume that expectations about the future are in large part based on observations of past and present magnitudes of the variables in question. One of the crucial factors is the time over which wages have remained at the current level. Wages may need to remain at a new level for some time before the perception of the change is incorporated into expectations.

The conventional formulation of the expected net present value of the returns to an engineering degree, V, is:

$$V = \sum_{t=G+1}^{R} \frac{W_t^*}{(1+r)^t} - \sum_{t=E}^{G} \frac{C_t^*}{(1+r)^t} \qquad \text{(III-1)}$$

where $C_t^*$ is the expected cost of education (including foregone earnings); $W_t^*$ is the expected incremental earnings attributed to possessing a degree in engineering (compared to the student's next alternative career); E is the age of entry into the engineering course; G is the expected age at graduation; R is the expected age at retirement; and r is the rate at which future earnings and costs are discounted. The value of V varies with the value of r, the former generally decreasing as the latter increases. For most earning streams, there will be some value of r for which V takes on the value of zero,

i.e., for which the present value of earnings is equal to the present value of costs. The value of r for which V = O is referred to as the internal rate-of-return. It should be added that in the formulation above, it is assumed that a period of full-time education is followed by a period of full-time employment--a simplifying assumption which is made only for convenience.

4. Motivation and constraints

The next elements of Figure III-2 are motivation and constraints. The basic assumption about motivation is the same as that underlying most human capital investment models (e.g. Becker, 1964; Ben Porath, 1967), namely, that individuals make education decisions in such a way as to maximize the net present value of the discounted stream of future earnings differentials associated with additional education. This assumption is particularly important in explaining occupational choice (Wilkinson, 1966). Thus there is a *prima facie* case that an increase in the current wage rate for engineers should cause more students to *want* to go into engineering. At this point a number of constraints on the responses of students become important.

a) social-psychological constraints: There are social-psychological constraints concerning the *ability*, *aptitude*, and *interests* of students. These factors are closely related to motivation, particularly the third one. A student confident of his ability to be either an engineer or an artist,

and perceiving his future earnings as greater in engineering than art but still choosing the latter career, may be said to be constrained by his interests in attempting to maximize his income. The constraint may be said to be perfect if he does not reverse his choice as the perceived income difference approaches the maximum that experience or credulity will allow as feasible.

It is likely that there are many children in the eighth grade with engineering aptitudes but not with engineering abilities. The difference between ability and aptitude may thus be conceived as temporal. On the other hand, aptitude may be conceived as a composite of ability and interest. At this point it is appropriate to deal cavalierly with this important difference, and speak of ability as the only important complement to interest as a social-psychological constraint.

To say that there are children or young people in Ontario (exluding the seriously handicapped) without the ability to become engineers (or physicians or teachers) implies two assumptions. First, that there exists some authority that establishes minimal performance standards that must be met by one who would hire himself out as an engineer (physician or teacher). Second, that some children either cannot meet those standards or cannot meet them without special preparation so long in duration or so expensive as not to be feasible.

For students who are or believe themselves to be in these two categories, there exists an ability constraint to their responses to changes in perceived wage differentials.

b) <u>financial constraints</u>: It is common to speak of financial barriers to education and to connote thereby both economic and financial constraints. In this section, however, financial and economic inhibitors to education are regarded as two closely related but distinct phenomena. Financial inhibitors will be treated as a very special sub-set of economic inhibitors.

To point up this important distinction, a few very simple hypothetical examples are useful:

1. A youth wishes to enrol in a university program. He does not have the money to fulfil his ambition, at least not without accepting what he considers an intolerable standard of living for some period of time, perhaps the rest of his life, as a consequence. A bank or financial intermediary is prepared to loan him the necessary funds to be paid back after completing his university program, and to do so at an interest rate that is considered "normal" or even privileged. On the basis of estimates of his future earnings minus the interest and principle payments on the loan, he still elects not to accept the sacrifice.

Certainly he faces an economic inhibitor. He does not, however, face what can properly be called a financial constraint.

2. Another youth wishes to take a university program. He does not have the liquid funds to attend, but he possesses assets that by usual "capitalization" techniques are adequate in value to cover his expenses. For one reason or another, he cannot liquidate those assets, or cannot liquidate them at less than an "intolerable" loss. Moreover, there is no bank or other financial intermediary that will accept those assets as collateral and loan him the funds he wishes to borrow at a "normal" or even "tolerably" high rate. He too faces an economic constraint, and it can be said to belong to that special set which are also financial constraints. He has a liquidity problem. He is not able to resort to the market or to fiduciary instruments to transform his assets. He cannot make effective use of the financial intermediaries.

3. A third youth wants to undertake a university program. He does not have the funds nor does he have any assets to sell or mortgage. He calculates that completing that program will add significantly to his future earnings. He is willing and able to repay

> out of that "extra" income a loan adequate to cover his expenses at university, assuming it is at "normal" interest rates, that normal rate being high enough even to include an insurance factor to cover the probabilities of his early death, disability, academic or vocational failure. Like the first and second youths, he labours under an economic constraint. Like the second, his is also a financial constraint. He has a liquidity problem. The financial intermediaries have failed him. Specifically, he is not able to "capitalize" the present value of his expected future earnings.

Some economists have argued that imperfections in the capital markets, notably discrimination as practised by financial intermediaries and the reluctance to fully capitalize future income streams, may be perennial causes of under-investment in education (Becker, 1964). It is also probable that these imperfections cause the intermediate (and perhaps the long-run) supply curves for qualified labour to be "less flat" than would otherwise be the case.

Not only might the imperfections of the financial market contribute to a general "shortage" of qualified labour, they may very likely cause the mix of qualified manpower to be different from that which would exist if the capital markets were perfect. This will happen if the difficulty in capitalizing expected future earnings is greater for some groups of

students than for others. If financial intermediaries discriminate against females, it may be supposed that we have under-investment in higher education leading to predominantly female callings. If financial intermediaries discriminate against the very young, it is probable that we have under-investment in those callings requiring very early specialization. Since we may assume the propensity of people to take loans at "abnormally" high rates to be greater for shorter periods and smaller amounts, it is hard to imagine that our capital market imperfections do not result in under-investment in very long training programs, unless, of course, association or other institutional limits to places in these programs keep the number enrolled below even that to be expected with imperfect capital markets.

The assumption of imperfect capital markets that have a perverse effect upon the level and pattern of educational investment is an important influence working to convince people that there should be government intervention in the labour market in the form of general or selective subsidies of educational programs. It is very difficult, though, to specify the form this intervention should take to correct for capital market imperfections.

Empirical studies show that the rates-of-return to certain types of education in Ontario (and elsewhere) are very high indeed (Systems Research Group, 1971). This does suggest under-investment in those programs, but it would probably be

impossible to parcel out the influence of financial constraints in bringing about this condition.

The "added cost" to education of imperfect capital markets is a more or less effective constraint on educational investment behaviour depending upon the price elasticity of the demand for education. The evidence of this is not adequate, but it does suggest that the price elasticity of this demand is quite modest (Campbell and Siegel, 1967; Handa, 1971; Handa and Skolnik, forthcoming). This price elasticity will be discussed again in Chapter VI. It is enough to note here that it suggests that financial constraints are probably not an overwhelming influence on educational investment behavior.

What may be of more importance than the effectiveness of financial constraints is our belief in their effectiveness. In the 1950s and 60s, quite obviously, many policy-makers in Canada and the U.S., particularly the U.S., were of the opinion that high wages and the high current value of expected future earnings in "scientific" callings were not adequate to evoke investments in and commitments to the educational programs preparatory to those callings. Financial (primarily preferential loans) and other economic inducements (primarily grants and scholarships) were offered as incentives to undertake such studies.

It is popularly believed now that those inducements were very successful. There is probably no way of determining, however, what part was played by those "extra" economic

inducements and what part was played by the value placed upon expected high future earnings in attracting students to undertake studies in science and technology. It would be more difficult still to parcel out the effect of financial inducements from other economic inducements.

What would be most interesting to learn--but almost certainly will never be known--is whether or not financial assistance only (i.e. access to loans at prevailing long-term interest rates) plus perceptions of future earnings would have resulted in the present redundancy (at expected wages and status) of highly skilled people in scientific callings.

At any rate, it must be emphasized here that all notions of a free labour market approach to the rational allocation of education resources to meet manpower requirements assume (among other things) the absence of financial inhibitors in individual investment decisions plus a consensual acceptance that there are no financial inhibitors to those decisions.

Though there is no evidence that financial inhibitors do reduce educational investments, and, as mentioned above, there is some very weak evidence that they do not do this to any important degree, it is unquestionably true that individual expected future earnings are difficult to transform into liquid resources. Not only banks dealing with individuals but also governments dealing in wholesale educational investment decisions and depending upon future tax-revenue streams for

repayment of educational investments, have been reluctant to capitalize (via fiduciary instruments) increases in future productivity.

This type of fiscal conservatism was endorsed by C. F. Bastable (1892: 670-671) eight decades ago. Financing "of the Prussian railways, or even the English telegraphs" by debt was sound public management. About investment in what we conventionally call human resources, however:

> A loan for the purpose of extending education, or for improving the housing of the workers, . . . may . . . so increase the income of the community as to make the tax receipts greater, without any increase either in rates or in rigour of collection. Regarded in the abstract such a proceeding seems defensible; the real objections to it arise from the difficulty of application. The results of expenditure of the kind are hard to trace or measure, and any statement respecting them must rest in a great degree of conjecture. . . . Prudence seems accordingly to suggest that borrowing should hardly ever be adopted except for strictly economic expenditure. . . .

Bastable was conceding that it is sound to balance revenues against expenditures minus some small portion of capital outlays, but they must be for substantial, locatable capital items about which it is possible to speak with some certainty of their imputed future revenue-income.

Things change a great deal in eighty years, but Bastable's views of the uses of public debt were progressive in his day, and many people today are not prepared to call them outmoded. Though there is a continuing evolution of government propensities to capitalize future productivity increments, it is still a politically--even if not economically--risky business. Bankers share with governments our evolving traditions of what is sound "financial" behaviour for both lenders and borrowers. Their reluctance to co-operate in the capitalization of expected future income increments is not very surprising.

Contemporary conventions related to borrowing and lending are determined by the progressive ideas of some decades or generations ago at least as much as they are by the "best thinking" about financial intermediary behaviour of today. Similarly, prevailing conventions about how to finance educational institutions and how to deal with student financial inhibitors do not all reflect the best and most advanced thinking of our times. Whatever may be the potential of "self-liquidating" individual education investments, even the ardent advocates of them as the means to optimal education investment behavior for our society admit that the fulfilment of that potential must wait upon some further evolution of institutions and conventions.

c) <u>flexibility of the educational system</u>: Another set of constraints has to do with the flexibility of the educational system, particularly the propensity to make policy adaptations at the system and institutional levels and the adaptability of resources.

Where specialization occurs late in the students' academic careers (as in the U.S. or Canada compared to the U.K.), the potential increase in supply is greater over a given time period than where specialization occurs at an early age. One is reminded of Lord Bowden's remark in the British House of Commons: "It is almost true to say that the destiny of our universities, their whole expansion programme, and with this, the whole destiny of this country, is at the moment in the hands of 14-year-old schoolboys" (quoted in Blaug, 1967: 273). Where specialization occurs early, students are making career decisions at points when they have minimal information; when their time orientation makes even intermediate range investment decisions difficult; and when the probability of changes in labour market conditions before they complete their training is high.

Related to the age at which specialization occurs is the length of the training period. The potential supply tends to be more elastic for occupations which have shorter training periods, and the length of training is an important factor in accounting for alternating shortages and surpluses of some types of manpower (to be discussed in connection with the

cobweb digram below, Figure III-3). Policy adjustments related to the age at which specialization occurs and the length of training periods are difficult to make and frequently avoided in all but the most flexible of systems and institutions.

The elasticity of supply is influenced also by the adaptability of the resources within the educational system. The physical and intellectual resources of the university may be so specialized that they cannot be transferred quickly from one discipline to another. Zaharchuk (1971) has shown that for one post-secondary institution in Ontario, tenured faculty posed the most serious obstacle to changing the course mix. In many secondary and technical schools in Ontario, elaborate shop and laboratory facilities, admittedly under-utilized, are found to coexist with inadequate library and other facilities. Changing priorities and emphases in educational programs have not been matched by the transformation of the physical capital available.

No one has devised a satisfactory measure of institutional flexibility; however, C. A. Anderson (1967) has dealt qualitatively with the adaptability of the U.S. educational system in the 1960s, citing the rapid expansion of linguistics programs as one of his chief examples.

5. <u>Market adaptability and the search for the new equilibrium</u>

Subject to conditions discussed in Sections III-B.3 and III-B.4, there will be some increase in the supply of

engineers after the disturbance of the initial equilibrium and the subsequent increase in wages. The question arises as to how the number of engineering graduates coming out of the pipeline after a given period will compare with the demand. This question can take two forms depending upon whether the demand for engineers is fixed or varies with the wage.

If employers' demand for engineers is completely inelastic with respect to wages, then the important question is whether the number of graduates coming out of the educational system will be less than, equal to, or greater than the number demanded, after allowances are made for those new entrants to engineering who do not come through the educational system. If the demand for engineers is somewhat elastic, then the relevant question becomes one of the level of wages needed to absorb the new supply: particularly, is it substantially above or below the earlier level?

a) <u>students' sensitivity to the educational plans of others</u>: Even if students could predict the total demand for engineers, their ability to make efficient career decisions will be hampered by their lack of information about the educational intentions of others. It is not enough to consider only the demand for engineers when evaluating the expected economic returns from studying engineering. A student must estimate also the likely expansion of supply and the consequent competition which he will face when he enters the labour

market. There are many potential sources of engineering manpower, as listed in Section B.2 above. Students may find it even more difficult to predict the expansion of supply from outside the educational system than that resulting from decisions of their peers. They cannot be expected to forecast accurately the increase in the supply of engineers resulting from decisions of other students, immigration and domestic migration, occupational mobility, and re-entry into the labour force. Yet they should show some awareness of these possibilities and the inclination to incorporate into their decision-making any relevant information that becomes available.

b) adjustments with wage flexibility: If wages adjust instantaneously to changes in supply and demand, no engineers will be unemployed. No matter how large the incremental supply associated with an increase in engineering wages, the entire pool can be employed in engineering through a substantial decrease in wages. Similarly, if the supply response is weak, the pool of engineers is allocated among employers by the price mechanism, and the wages will be high.

On the other hand, if wages are not flexible then there may be unemployment of some engineers, as will be discussed in more detail in Section 5.c below. Even if wages are sufficiently flexible to avoid unemployment of engineers, several problems may arise in relying on wage adjustments to secure equilibrium.

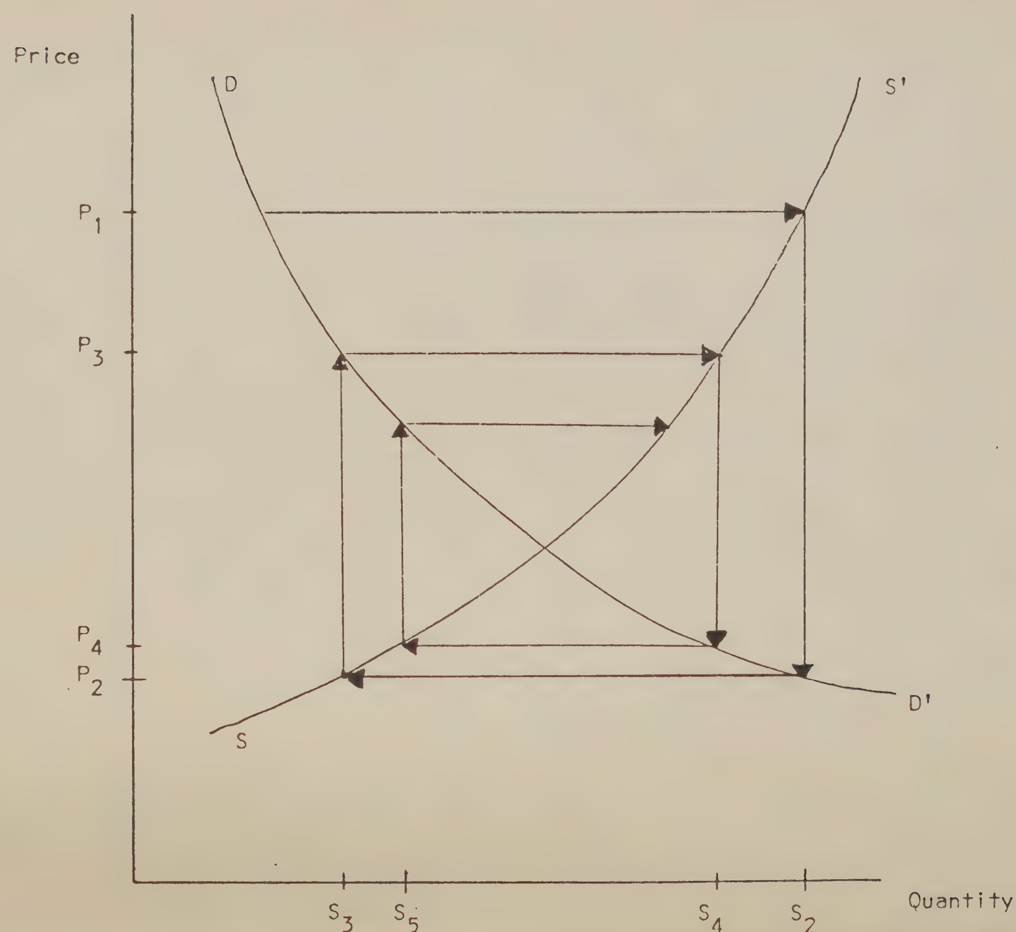
The fluctuations in wages needed to bring the labour market into equilibrium may be great. The potential magnitude of these fluctuations can be illustrated by the cobweb diagram, developed initially to illustrate the vagaries of certain agricultural markets and to justify government intervention in agricultural marketing (Hanau, 1930). The basic conditions which give rise to cobweb effects in agriculture are the multiplicity of small independent producers and the relatively long production processes.

The general cobweb model is depicted in Figure III-3. Quantity is measured on the horizontal axis and the price on the vertical axis. It is assumed that current supply ($S_t$) is a function of last year's price ($P_{t-1}$) and that current demand ($D_t$) is a function of this year's price ($P_t$). The initial price is $P_1$. The high price will induce a large supply, $S_2$, in the next period. The resulting excess will drive the price down to $P_2$. The next period's supply will be only $S_3$, driving the price up again, and so on. The cobweb in Figure III-3 converges after many periods. Convergence will not occur under all conditions. There may be an ever-increasing amplitude of the fluctuations or a perpetual cycle.

With such large fluctuations in prices, or wages, speculative gains or losses are to be expected. Hollister (1967: 248-50) has argued that such large gains and losses are

Figure III-3

The Cobweb Model



inequitable. He has suggested that government intervention in the labour market is justified to prevent excess earnings. One must be cautious to distinguish between excess earnings which result from monopoly power and those which are speculative profits. While few men of goodwill countenance monopoly returns, most economists regard speculative profits as an inevitable consequence of reliance upon a free market system for resource allocation. Hollister recognizes this inevitability and for that reason proposes to intervene in the market.

Others are not so concerned about speculative profits, noting the positive role that speculation can play. However, in a market characterized by cobweb effects, there is another problem to consider besides that of equity. Investment decisions are difficult in such circumstances. The fluctuations may be so serious that individuals cannot base their decisions on the average expected earnings. In general, only the well-financed entrepreneur can afford to be guided by average expected returns. Even for the well-financed, the timing of the entry onto the labour market is of great importance. If they graduate during a glut in their field, although employed, they may not be able to get the kind of experience in their first few years which will enable them to advance rapidly in their careers. In this case wage flexibility will have insured that new graduates are employed,

but they may feel that their potential capabilities are being under-utilized. They are not underemployed in an economic sense, since presumably they are pursuing their best employment opportunities. However, in a technical sense, these graduates may be underemployed. Unfortunately, there is still very little known about the link between education and employment, and no one has succeeded in specifying the optimum education for particular occupations.[1] Without considerably more research in job analysis and job specification, it is not possible to make objective statements about under-utilization of skills--however strongly one may believe under-utilization to be the case on intuitive or impressionistic grounds.

c) adjustments with limited wage flexibility: It has been argued above that even when wages are completely flexible, there will be inefficiencies in the adjustment process following changes in the demand for and supply of highly qualified manpower. If wages are not flexible, then the adjustment problems are likely to be even more serious. This section will consider whether there is much wage flexibility in the market for highly qualified manpower and the nature of labour market adjustments that take place in the absence of wage flexibility.

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[1]Research on the link between education and occupation is discussed in Chapter V.

i) <u>the reality of wage flexibility</u>: It is important to record that there are no definitive conclusions that can be drawn from empirical studies of the flexibility of wages for highly trained manpower. It would be easy to measure the variability in wages over time, or between regions, for particular occupational groups, and this has been done (Keat, 1960). However, this is not evidence of wage flexibility as the term is used here. In this context flexibility does not pertain to absolute difference or changes in wages, but to changes in wages related to changes in supplies. This relationship is difficult to ascertain because of the absence of reliable data on supplies. For example, even consistent data on the numbers of engineers and technologists employed in Ontario is not available. That would be only minimal information. One would need to know also the numbers of engineers who are unemployed, the numbers working at other occupations, the numbers who have gone back for further education, and so on.

Unfortunately, there is no study of engineers which gives the kind of information which Ribich (1968) has reported for the semi-skilled in the U.S. Surveying studies of retraining programs, he noted that in most cases those who had completed retraining received the same hourly rates as comparable

workers who had not taken retraining, but that the former had fewer weeks of unemployment during the year. This suggests that at least one type of labour market adjustment is made through employment rather than hourly wages.

In the absence of conclusive empirical data, one must consider the various theoretical arguments concerning the likelihood of wage flexibility. Mr. W. Reder (1955) has provided one of the best discussions in this area. His main point is that in a number of situations employers find it more rational to adjust hiring standards than wages rates particularly when raising wages is the alternative. He begins with the conventional oligopoly argument for wage stickiness. If an employer attempts to hire more engineers in a tight market by raising wages, his competitors are likely to follow suit and all employers soon find themselves worse off. In an oligopolistic situation, unlike a competitive one, firms are aware of an identity of interests and resist temptations toward pirating, as toward price-cutting.

He notes further that altering hiring standards enables the firm to practise wage discrimination. When a vacancy is filled by promoting a worker of a lower grade (e.g. a technologist to engineer), the "increased compensation need be paid only to the promoted workers" (1955: 835). However, if higher wages are offered to attract additional engineers, the higher wages must be paid to all of the other engineers. The potential savings from wage discrimination are so great that

upgrading may be more profitable even though the employer must absorb the costs of training the promoted worker in addition to his salary increment. Reder notes that only where there is critical danger of property loss from incompetent workmen will changing hiring standards not be considered, provided that laws and professional associations allow it.

Most of what has been said above applies to reluctance of employers to make upward adjustments in wages. A powerful factor operating against downward adjustments is the influence of unions and professional associations. Consequently, it is generally easier to downgrade some workers than to lower the wages for the whole class of workers.

While there is little evidence on wage flexibility, as noted above, the presumed existence of unemployed professionals during a time of continuing rising professional earnings suggests that downward wage flexibility is not a principal means of labour market adjustment. Professional associations as well as trade unions seem to prefer this state of affairs to spreading-the-work stratagems.

ii) <u>adjustments with limited wages flexibility</u>: Suppose that, for any of a variety of institutional reasons, wages are not free to increase beyond the initial equilibrium level of $W_1$ in Figure III-1. At that level, employers would like to hire $Q_3$ engineers, but only $Q_1$ are forthcoming. Employers would

attempt to meet the shortage by employing non-engineers in engineering work.[2] They may resort to vertical transfer, e.g. upgrading of technologists, technicians, and tradesmen. In addition, or instead, they may use horizontal transfers, exploiting scientists and mathematicians as engineers. However, it may not be possible to substitute workers of other occupational categories for engineers without loss of efficiency in production, i.e. substitutability between different occupational groups may be low. Then the combination of excess demand and lack of wage flexibility will entail a loss of potential efficiency. However, the more limited the possibilities for substitution, the greater will be the inducement for employers to raise wages in an effort to increase the efficiency of allocation of manpower.

Suppose that there is an excess supply of engineers at the existing wage rates, and that wages are inflexible downward. Three possible results are suggested, all of them inefficient. A number of engineers may be unemployed. There may be inflation of hiring standards for engineering work, with engineers doing work previously considered appropriate for technologists and technicians. The engineers will be underemployed in terms of their technical skills and expecta-

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[2] Employers may try to recruit engineers from outside the province before resorting to the use of non-engineers. Immigration has been an important source of highly qualified manpower in Canada and Ontario, as discussed in Part B of this report.

tions. Engineers may transfer to other fields of work.

A large number of educated people end up working in occupations different from the one in which they received their principal training in any case.[3] Frequently, the reasons for the change are complex and non-economic. Moreover, the individual is often more satisfied and productive in the new field. Presumably, however, there is another class of occupational transfers, those motivated primarily by the inability to find employment in the main field of training. In these cases, the individual is assumed to be neither happier nor more productive in the new occupation.

d) <u>the nature of production functions</u>: Little has been said to this point about how skilled manpower enters into the production process. We have assumed a downward sloping demand curve for engineers, and we have not probed the underlying basis of this curve. Now it is necessary to examine the role of skilled manpower in production, and to consider alternative models of production.

The two opposite extremes with regard to assumptions about substitution are the neoclassical and Leontief production functions (Blaug, 1967). The essential characteristic of the

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[3] For some evidence on the relation between field of education and field of employment for Canada's highly qualified manpower, see Atkinson, <u>et al</u> (1970: 82-86).

former is smooth substitution between different categories of labour and between labour and other factors. Employers adjust to a variety of combinations of supplies of skilled manpower. This is presented graphically in Figure III-4. The curve FF' is the isoquant showing the combinations of the two skills, X and Y, which can be employed to produce a given level of output. Employers are assumed to choose the combination of the two groups which will minimize production costs. The ratio of the employment costs of the two skills is given by CC'. The iso-cost line is assumed linear for convenience. The least cost combination corresponds to the point of tangency between CC' and FF'.

What Blaug refers to as the Leontief production function is represented by the right-angle isoquant FF' in Figure III-5. It indicates the unique amounts of each of the skills required to produce a given level of output. If the factors are supplied in anything but the required proportion, some of one factor must be idle at any level of production. For example, with supplies $OY_2$ of Y and $OX_1$ of X, the output indicated by FF' will be produced with X fully employed, but with $Y_1Y_2$ of Y redundant. Alternatively, if there is less than $OY_1$ of Y, output must be less than the level described by FF', and some portion of X will be idle. It may be noted that the required amounts of X and Y for the given level of output are independent of relative wages, i.e. of the slope of the isocost line CC'.

Figure III-4

Neoclassical Production Function

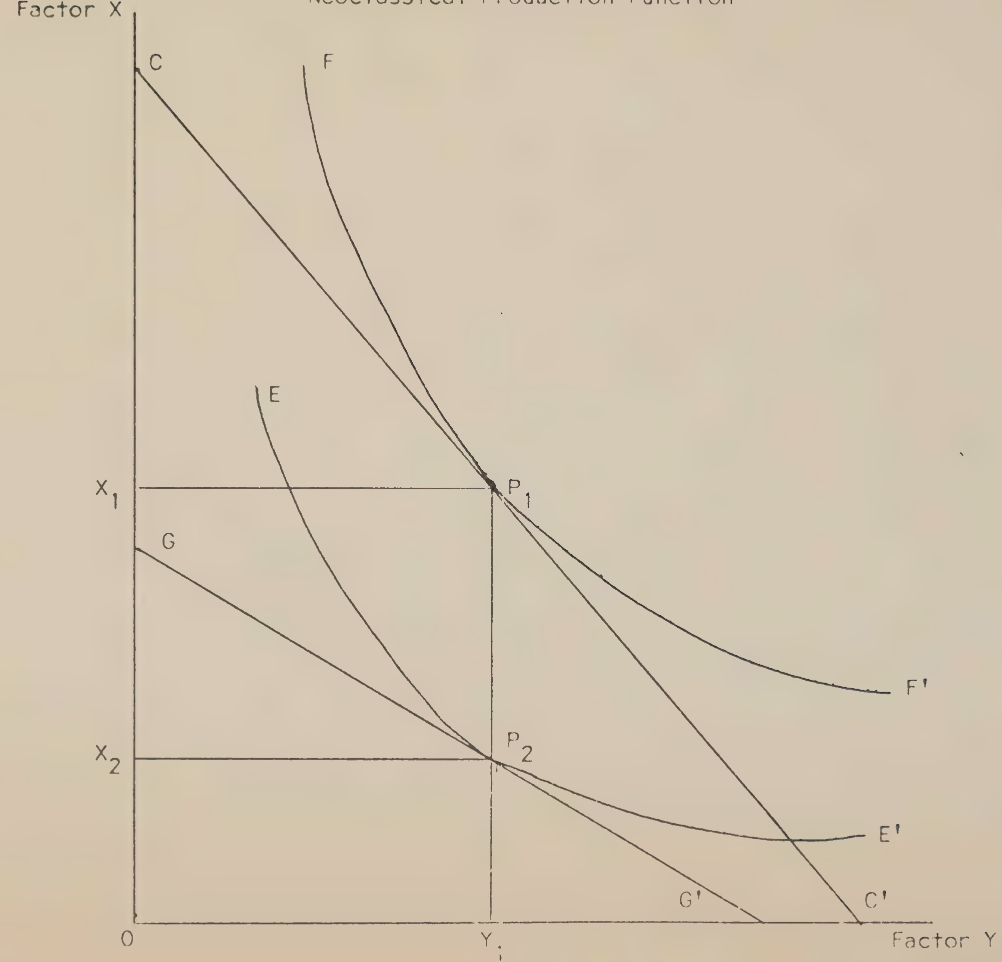
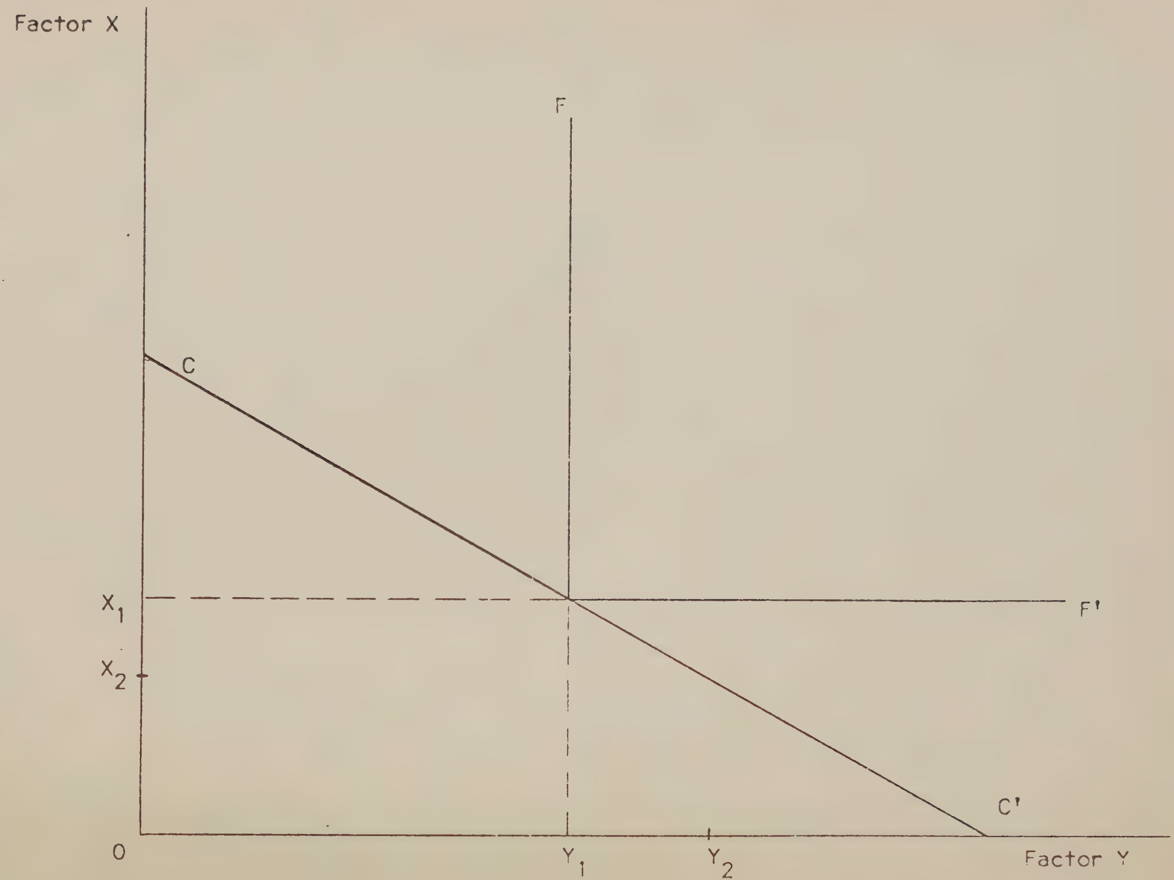


Figure III-5

Leontief Production Function



Most of the manpower planning literature assumes the world to resemble the Leontief model more than the neo-classical. This leads to the conclusion that there is a precise number of engineers required by the economy. If there are fewer engineers, all engineers will be employed, but there will be unemployment of other factors of production and a loss of potential GNP. If there are more than the required number, the excess will be either unemployed or under-utilized in other types of work.

The important point here is that in a Leontief world, manpower requirements are precise. Shortages and surpluses are certain to be costly, and adjustments will occur slowly if at all. It is no wonder that those who share this view of the economy tend to advocate centralized manpower planning[4] (Parnes, 1962).

We should note the similarity between the effects of wage rigidity and Leontief production conditions. Suppose that the supplies of specialized labour X and Y are $OX_1$ and $OY_1$, respectively, in Figure III-4. The ratio of their wages at which both groups will be fully employed is that given by line CC'. Suppose, however, that wage rigidity makes the ratio of the wage for X to that for Y higher than the full

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[4]The nature of production conditions, especially the extent of substitution between various factors of production, has important implications for manpower forecasting which will be discussed in Chapter V.

employment ratio. The higher ratio depicted by GG' exceeds the full employment ratio CC'. The most efficient point of operation under the new condition will be the tangency of GG' with the lower isoquant (representing lower output) EE'. One of the skill groups, Y, will be fully employed, but $X_2X_1$ of X will be unemployed. In practice, it is very difficult to tell whether unemployment of highly trained manpower is a result of wage rigidity or Leontief production conditions.

C. Recapitulation

The conditions under which the unco-ordinated educational investment decisions of individuals serve objectives of manpower policy (II-B) have been discussed, and some of the inter-relationships have been depicted in Figure III-2. In brief, those conditions are:

1. pecuniary motivations operating in career choices;
2. wage flexibility;
3. information available to students about earnings and employment probabilities;
4. formation of expectations by students about education and employment prospects on the basis of (3);
5. the absence of social-psychological constraints on career and educational decisions;
6. student sensitivity to the career and educational decisions of others;
7. absence of financial constraints;

8. flexibility in educational institutions and systems.

These may be offered as necessary conditions for the fulfilment of manpower objectives without tampering with education policy. It is not supposed that over the conceivable range of necessary (by efficiency criteria) adjustments in the allocation of highly qualified manpower, and in the allocation of resources to training that manpower, each of these conditions will always be critical to the fulfilment of manpower objectives via free educational investment behaviour. On the other hand, it is not difficult to hypothesize necessary adjustments that cannot be achieved without the existence of any one of these conditions.

Certainly the probability that any one of these conditions will be critical to efficient qualified manpower use and training is determined by a number of other conditions or factors. Further, it is not to be supposed that the absence of one of them will make the same contribution to inefficiency or the inadequacy of a system of free educational investment decisions as would the absence of any other. For example, if one does not assume condition (1) to prevail, any discussion of serving manpower objectives via the market is absurd. However, one might be prepared to concede that conditions (5) and (7) don't characterize our society at this time, and still be prepared to argue that free educational investment decisions are the more efficient approach to preparing and allocating

qualified manpower. Finally, it is not supposed that the absence of one or more of these conditions in our society will affect all educational investment decisions the same way or to the same degree.

Among the factors that contribute to the probability and degree that one or more of these conditions will affect efficiency are:

1. the age at which specialization normally occurs in a society;
2. the variation in the ages of specialization for different callings;
3. the length of training periods imposed upon entrants to highly qualified occupations generally;
4. the variations among those training periods;
5. the frequency, regularity and severity of demand changes for highly trained manpower;
6. the wage elasticity of supply emanating from sources other than formal training programs;
7. the nature of the general and disaggregated production functions that characterize an economy.

These factors can reasonably be considered second-order determinants of the efficiency of a manpower policy based on free educational investment decisions.

Of course, adjustments are not only made, they are made over some period of time. The importance of this is related

to the fact that impatience is a common human frailty, and sometimes a virtue. It is not uncommon for people to concede that there is a best way of doing something, but to shun that way because it takes too long. Numbers (1) and (3) of the second-order determinants of efficiency in the approach under consideration refer to conditions in our educational system that may well be called inertia. When early ages of specialization and long periods of training cause certain shortages of trained manpower to appear to be secular developments which are not likely to be self-correcting, interference is frequently unavoidable. When natural impatience is exacerbated by enthusiasm for national accomplishments such as matching the educational opportunities of the United States, or Canadianizing education and the economy, the temptation to interfere with the market can become overwhelming even for those who believe the market will in time produce the best, or the ideal adjustments.

This inertia has been singled out as the main ingredient in the alternating shortages and surpluses of qualified manpower (Arrow and Capron, 1959). This prolonged or perpetuated disequilibrium can be so frustrating to so many people that not to interfere to end it can be politically out of the question. It may be better to interfere even if there is good reason to suppose that non-interference is in everyone's long-run best interest. This inertia combined with undesirable

conditions regarding number (5), i.e. with shifts in demand that are frequent, irregular and severe, can produce results so upsetting and complex that the best adjustments are difficult even to articulate. In this case, not only may interference be a political necessity, but it may also be impossible to evaluate, and may or may not contribute to the condition it is intended to eliminate.

In any case, with ideal or even satisfactory results via the market and free educational investment decisions dependent upon such a demanding bill of specifications, it would be difficult to convince anybody that at least some improvements cannot be realized by market interventions working at the edges of the system. Moreover, it is so easy to imagine a set of conditions under which the market approach is pure absurdity, it is not surprising that at any point in time many people believe one of those sets of conditions is in fact the case, and sometimes it is difficult to find people who do not believe one of them to be the case.

## D. Post-Secondary Education and the Economy of Ontario

Ultimately, the case for the rationality of a manpower-based education policy depends not only upon an assessment of the degree to which the necessary conditions for a properly functioning system of individual education and employment choices characterizes an economy, but also upon an understanding of the immediate and longer-run effects of every intervention stratagem.

There is no hope in our time of meeting that second requirement of perfection. Our very inclusive models and other abstractions of economic activities and relationships are simply not adequate to the challenge. However, empirical research probably can provide us with cumulative information about the degree to which these conditions warrant some interventions. At the very least, this information can be expected to indicate circumstances that constitute a logical basis for saying unequivocally that we cannot prove intervention in the market to be a source of inefficiency. Since there is so little we can say for sure about the behavioural results of policy, knowledge of this type is not to be lightly dismissed. Furthermore, negative findings, though inherently unexciting, can be powerful liberators to policy-makers. As with the rest of us, it is sometimes comforting for them to know that they are not certain to be wrong, even if they cannot know that they are right.

As will be pointed out in the concluding chapter, a priority of empirical research on the labour market and post-secondary education can be suggested with the hope of improving our understanding of the sources of inefficiency in delivering qualified manpower to the economy. It will also be pointed out why such research results are currently inadequate bases of even cautious manpower policy. At this point, however, it is appropriate to mention a few of the problems in assessing the prevalence of the above mentioned conditions.

The 1960s, particularly after 1963, were notable in Ontario for economic growth and expansion of the educational systems, especially the post-secondary system. It was generally accepted that the educational expansion was necessary to the economic growth (occasionally it was pointed out that the opposite relationship or both relationships might be the case). It was not a very long step from this popular acceptance to the general conceptualization that education is an industry very much like other industries. If not for this very secular and very modern view of education, such reports as this one and others now being prepared for the Commission on Post-Secondary Education would be inconceivable.

However, the fact that the economic and educational expansions were simultaneous makes it very difficult to speak of the manpower aspects of the relationship between them. Ontario during this period was an outstanding example of the fact that a jurisdiction need not be hampered in the expansion of its modern sophisticated industries by the inadequate local supply of highly trained workers those industries require.

The factor of production that is labour moved with alacrity over our provincial and national boundaries. The more certifiable the qualifications, the greater that alacrity. Whatever the importance of educational expansion to economic growth, in this case there was no sequential connection. The presence

of favourable educational opportunities from elementary through post-secondary school for the offspring of workers may have been necessary to attract and hold our highly qualified labour force. Our industry was not, however, entirely dependent upon the products of our school system to meet its highly qualified labour requirements.

The economy of Ontario is considerably less expansive now than it was during most of the 1960s, but it is now that the products of the educational expansion of those years are presenting themselves to industry. Doubtlessly, the present recession complicates the understanding of how effectively our post-secondary educational system and individual student decision-makers responded to the manpower needs and opportunities of Ontario industry. To this we add the facts that our greatest educational expansion period is a very recent historical phenomenon, and that Ontario is a very open economy. It is little wonder that at this point in our history we do not have adequate information about how well, i.e. how efficiently, our post-secondary educational system and students were serving our manpower needs in recent years, and about which conditions of our economy were contributing to inefficiency in that joint behaviour.

E. Summary

The case for a manpower-based educational policy depends upon the degree to which the objectives of a state's manpower

policies are achieved through relying on the unco-ordinated career decisions of students interacting with decisions of employers and educational authorities. Chapter III considers the conditions under which these manpower objectives will be achieved without specific intervention in the educational system and in the market for qualified manpower. Through an examination of the workings of the market for highly trained manpower, sets of first- and second-order conditions for the achievement of manpower objectives are deduced. Some attention is paid to the prevalence of these conditions in Ontario and the consequences of the absence of some of them. However, it is emphasized that existing data and research results do not justify anything more than very cautious statements in this regard.

Both the question of whether or not to interfere and how to interfere can be answered only if one understands or is willing to make assumptions about what things determine the propensity of people to offer themselves on the labour market, and the propensity of employers not only to hire them but to choose among them in certain ways.

Our knowledge of the motivations and constraints working on potential qualified workers is, to be sure, inadequate to the task of estimating the consequences of policy alternatives. Even if we assume that the supply and demand for labour behave "conventionally," i.e., that wages and wages-expectations do affect the short-range and long-range

supplies of qualified labour and that marginal productivity expectations do affect the demand for qualified labour, we have the next question in the chain: do existing institutional arrangements allow the behaviour of employees (and potential employees) to effect an efficient mix of qualified labour?

Whatever the reality or the assumptions about the effects of such institutions as unions, professional associations, employer combines, minimum fees or wages, etc., on the efficiency of labour mixes and/or upon the policy objectives related to full employment, one is left with the most difficult question of all. Is the most efficient policy one of attacking the inhibiting institutions or of interfering more directly to affect supplies of and/or demands for qualified labour?

All of the questions raised here have been raised countless times before, in connection with qualified labour markets, the labour market more generally, and all other kinds of markets. One of the points emphasized in this discussion is that highly trained labour, with its long production process, may, like some agricultural products, be expected to defy simple solutions to problems of alternating shortages and surpluses.

About the only thing that can be said for certain about the state of the theory of market behaviour and its implications for intervention is that there is no logical basis for

saying unequivocally that intervention is always a source of inefficiency.

Apart from the general or typical case, there are special problems in Ontario associated with understanding either the relationships between wage variations and the supply of skilled labour, or the role of institutional arrangements in determining that relationship. These problems are associated with the facts that our education expansion has been so recent and our economy has so energetically tapped sources of skilled labour outside Ontario and outside Canada.

# CHAPTER IV

## ALTERNATIVE ANALYTICAL BASES OF MANPOWER PLANNING

In this chapter it is assumed that reliance upon the unco-ordinated investment decisions of students does not lead to the realization of manpower objectives. Some form of manpower policy working to influence and co-ordinate their behaviour is therefore warranted. This assumption raises the question of what type and degree of intervention is warranted. This in turn suggests an antecedent question: what should be the analytical approach to selecting or evaluating policy objectives derived from manpower goals?

### A. Institutional Change

The economic argument for intervention in the manpower market (including educational investments) rests upon the existence of conditions under which the manpower market functions inefficiently. One logical possibility is to attack those conditions so that the system will work efficiently without a policy of continuing intervention. This approach can be appropriately termed institutional change. One might note the irony that this is intervention to make intervention unnecessary.

Institutional change may be a very desirable policy choice for frank ideological or normative reasons. Faith that a market without monopoly or intervention is an inherently good

thing is not uncommon. Conviction that intervention is justifiable in only the severe cases of conflict between individual and public interests is even more common. The institutional approach to labour market and education policy perfection may be warranted also because there is a shortage of empirical and deductive evidence supporting the efficacy of proposed interventions.

The conditions identified in Chapter III as determining the efficacy of individual education investment decisions are amenable to modification by institutional change (redevelopment or improvement). In so far as the related value and behavioural complexes concerned are centred in the educational system, a vigorous reform of educational institutions can be very effective.

A number of the implied reforms, however, are beyond the scope of educational authorities. For example, we do not ordinarily expect the extent to which pecuniary motivations determine student career choices to be within the influence of educational authorities, even though children probably acquire their values regarding education and income in school as much as anywhere else. In fact, we do not ordinarily consider so fundamental an institution as the cash nexus as subject to planned change. Nevertheless, it is instrumental to a smoothly functioning market system. Greater wage flexibility may be an appropriate institutional adjustment, but

it is not only beyond the control of educational authorities but is also an accomplishment that eludes the most influential politicians. Eliminating restrictive certification of manpower is an equally difficult goal of institutional change.

Furthermore, most of the reforms that would make the educational system (or any other institutional complex) more flexible have a cost. The cost may be in such form as a requirement for greater capacity or more general training. These can be translated into dollars, and may exceed the dollar cost we are willing to pay for the reforms. Thus it is important not to speak loosely of flexibility; that is, it is important to examine the costs as well as the benefits (Hollister, 1967). No one has succeeded in measuring these costs and benefits of flexibility, not even crudely. It is interesting to note that Hollister has taken Anderson's (1967) previously noted piece on flexibility in the U.S. educational system to task for neglecting the costs of that flexibility. Blaug's (1967) discussion on transforming a world of Leontief production functions to a world of neoclassical production functions is pertinent to this. Nevertheless, empirical and theoretical contributions here have been modest. Certainly, no one has dealt definitively with the "style" or "character" costs of educational reform. Those inflexible educational institutions contribute in large measure to making a society what it is, and societies, like

individuals, are not always anxious to cease being what they are.

B. Promoting Efficiency within the Existing Structure

It is claimed quite frequently that there are three basic approaches to educational planning (e.g., Wilkinson, 1964): (1) the social-demand approach; (2) the rate-of-return approach; and (3) the manpower-forecasting approach. Actually, they are only approaches to a few salient problems of educational policy, mainly determining the number and type of places to provide in an educational system.

The social-demand approach is probably poorly named, and usually means that economic objectives are not being considered. Though it can mean other things, the connotations of the social-demand approach are the acceptance of the unco-ordinated decisions of students as the source of demand for places, the accommodation of those students as a policy objective, and the prediction of the number of places required at different points in the future as the main task of planning. The social-demand concept will be given more careful attention in Chapter VI.

Educational planners and economists who believe social-demand studies to be an inadequate or erroneous analytical basis of manpower-educational policies usually resort to rate-of-return studies or manpower studies. A number of lengthy comparisons of these two approaches or types of studies have been produced

(Blaug, 1967; Bowen, 1963). However, a few points about each approach that have not yet been emphasized elsewhere should be dealt with here.

1. Manpower forecasting

The basic assumption necessary to manpower forecasting is that the demands for labour by types in an economy are predictable over the periods of time for which economic plans are usually constructed, five or ten years and sometimes longer. An ancillary assumption is that quite specific fulfilment of these demands is necessary to the accomplishment of production goals, in fact the same production goals from which the estimates of manpower requirements are derived. The categories of labour for which demand forecasts are made are defined either in terms of occupation or education. The literature on manpower forecasting is weakest in its demonstration of how the forecasts should be used, or how they should influence policy. It is natural to presume that when these projections indicate that in meeting output goals the demand for certain classifications of workers will be less than the supply from the educational system, admissions should be generally or selectively restricted, and that when the forecasted demand is for more workers than the educational system has been and is producing, admissions should be increased. However, there has not been adequate treatment yet of either the means of implementing these restrictions

and increases or of the repercussions of such actions. If manpower forecasting is to be regarded as a basis for manpower policy, it is appropriate to divide it into two components, the analytical component and the implementation. The latter will be discussed in Chapter VI.

Faith in manpower forecasting, or the analysis of future manpower demands, requires a belief in the technological determination of the size and skill-characteristics of the labour force for a given level of output. It also requires a conviction that the manpower/output co-efficients will be stable for the period of the analysis or change in some predictable way. Similarly, it requires a rejection of relative wages as a determinant of the occupational structure of the labour force, and of changing labour supplies as a determinant of the manpower-mix associated with a given output. Put in economic terms, there is zero elasticity of substitution among types of manpower. Manpower forecasts, therefore, require concomitant forecasts of shifts in demand for goods and services, and of technological changes. Some of the pitfalls of these types of forecasts that arise when we relax the assumption of zero elasticity of substitution will be discussed in Chapter V.

2. Rate-of-return analyses

The analysis of rates of return to education is the systematic comparison of the benefits to the costs for some unit of

educational investment. It gives information on the supply-and-demand relationship in the form most useful to investment decisions. It indicates the areas where returns to educational investment should be largest--at least to the next worker with that kind of education going into the labour market. It is not a forecasting tool.

Unfortunately, the fact that rate-of-return studies give us information on past investments means they are valid investment guides only to "the small investor", the person in a position to purchase a "few shares" of education, e.g. the youth who can, with a few months of study and a small tuition fee, be employed in an occupation for which there is high demand. The large investor, the one whose behaviour is likely to upset the antecedent conditions of a correct decision, must be careful of rate-of-return studies. Educational authorities who influence or determine the behaviour of thousands of students are big investors in this sense. An investor's prime concern must always be with the expected return to his next unit of investment. Probable returns on marginal investments must guide his behaviour. His concern should not be for average relationships or for past marginal relationships. A disconcertingly large portion of the economic studies of education during the 1960s made much over the evidence of high average returns to educational investments

and the supposed importance of this to educational policy makers. The concern should have been on improving policy makers' insights regarding the points of probable rapidly diminishing returns to increased investments. The fact that well-qualified economists treated high average returns to educational investment as reliable guides to investment decisions raises some interesting questions about the sociology of economic science.

It has been suggested that the present clamour for "accountability" from the educational sector may be due to the failure to recognize the importance of the difference between average and marginal returns to educational investment in the 1960s. If accountability requires anything in education and the rest of the public sector, it is the rewarding of managers and policy-makers according to their mastery of marginal benefit-cost estimates (Holland, 1971). Given this confusion between average and marginal, rate-of-return analyses can be dangerous to decision-makers in the public sector under the present conditions of popular discontent with the supposed returns to investment in education and concern over the high level of expenditure on education.

Hagen (1968), among others, has stated that the rate-of-return approach assumes infinite elasticity of demand for the types of manpower currently enjoying high rates of return to their educational investments. This means unlimited expansion

of supply will not depress the rate-of-return. This can, of course, approximate actual conditions only in the short run, perhaps the very short run. At some point the rate-of-return must fall. Strangely enough, studies of this name do not place any importance on indicating where that point is.

The only way to estimate when the point of diminishing marginal returns to investment in education might be encountered is through some kind of forecasting of demand and supply, in essence through manpower forecasting. This suggests that rather than being looked upon as alternative approaches to planning, rate-of-return analysis and manpower forecasting should be viewed as complementary.

Rate-of-return analysis by itself can be useful for short-run policy-making. In the short run it can be used as the basis for a policy of spotting and eliminating successive disequilibria in the market for highly qualified manpower. The goal of the manpower forecasting approach is to prevent just such disequilibria. If these short-term disequilibria are costly and can be eliminated only with much time and difficulty, then longer-term planning is advisable. In general, the factors and conditions designated in Chapter III as making intervention in the market process desirable also make medium to long-term planning desirable. Some analytical technique which gives medium- to long-term forecasts, say five to ten years, will be necessary. This is manpower forecasting.

C. Summary

In this chapter the analytical bases of manpower planning are grouped dichotomously under the headings of institutional change and of promoting efficiency within the existing institutional structure. All bases of manpower planning subsumed under institutional change are assumed to be approaches to reducing the institutional inhibitors to freer markets and to greater sensitivity of supply and demand to changes in wages of highly qualified manpower. Since the concept of countervailing or compensatory institutional arrangements is not considered, it is noted that such interferences may be described as interventions to eliminate or reduce the usual justifications for intervention.

It is emphasized that many of the sources of inflexibility in our system of determining labour supplies and labour mixes via wage adjustment are not within the domain of educational policy-makers at any level. Furthermore, it is emphasized that reforms that make an educational system more flexible have costs--not only dollar costs in our training programs and selections systems, but also costs that can be expressed in terms of undesired changes in our educational styles or character.

Most of the schemes for promoting efficiency within the existing structure can be said to have as their analytical bases one of the "three basic approaches" to educational

planning: (1) the social-demand approach; (2) the rate-of-return approach; and (3) the manpower-forecasting approach. It is emphasized here that actually these are approaches to only a few salient problems of educational policy.

The conditions under which the social-demand approach could be adequate for dealing with problems of efficiency have been discussed in Chapter III. Here it is emphasized that the popular alternative to the social-demand approach--rate-of-return studies--is of little value for planning over any but a very small piece of the future. These studies emphasize average returns and past experiences whereas what we need are insights regarding the points of probable rapidly diminishing returns to increased investments. Rate-of-return studies were the basis of most of the arguments in the 1960s to the effect that we were under-investing in education.

Rate-of-return studies are probably of more value to individual students, faculties and small or medium-sized institutions than to educational policy-makers for large systems. They may also be of value to large systems in spotting and dealing with important supply bottlenecks. What is needed for more general long-range planning for large jurisdictions, however, is some system of long-term forecasts. In spite of the large number of caveats offered here about manpower forecasts, it is conceded that they are about all that exists as an analytical basis for long-range educational planning.

# CHAPTER V

## MANPOWER REQUIREMENTS PROJECTIONS

### A. The Meaning of Manpower Requirements

The term "manpower requirements" has been the source of much confusion. The term refers to the occupational configuration of the labour force that will be necessary if certain social and/or economic targets are to be achieved (Parnes, 1962: 18). This assumes that there is a definable functional relationship between the level and composition of national output and the occupational structure of the labour force. Most observers would agree that in general this is true. It is unlikely that Canada's current level and composition of GNP could be maintained if the Canadian labour force had the same occupational structure as Chad or Haiti. On the other hand, changes of, say, 10 per cent in either direction in the number of engineers, scientists, lawyers, economists, etc., may not seriously damage the functioning of the economy.

#### 1. The uniqueness of manpower requirements

The problem is in ascertaining just how much flexibility there is in the economy. If there is great flexibility--so that the economy can adjust to nearly any occupational composition--then the concept of manpower requirements becomes meaningless. The concept is meaningful only if there are significant limitations on substitution between different types of manpower. We cannot give precise definitions of

"great flexibility" or "significant limitations on substitution." We wish to emphasize, however, that the concept of manpower requirements need not be taken to imply that there is a *unique* occupational composition for a particular level of GNP, and that level of GNP cannot be sustained with any other occupational composition. This would be a far too restrictive notion of manpower requirements, in fact a *reductio ad absurdem*. A more realistic view of manpower forecasting would be to *describe the range of feasible sets of manpower requirements* for a given level and composition of GNP.[1]

Unfortunately, as will be seen below, in most of the quantitative models of manpower forecasting, manpower requirements are defined in terms of a point rather than a range. The mathematical models of production upon which forecasts are based usually assume a *unique* relationship between various types of manpower inputs and economic output, i.e. they are Leontief models. Nevertheless, it is still possible to present a range of feasible requirements forecasts rather than point estimates as most studies have done.[2]

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[1]After defining the feasible sets of manpower requirements one may attempt to select the optimal set according to a specified criterion. Two possible criteria are minimizing the costs of education or minimizing the total employment costs for the manpower bundle. These criteria may give different solutions (Skolnik and Smith, forthcoming, 1972).

[2]In Part B of this report, a range of projections of highly qualified manpower requirements will be presented.

An increasingly large proportion of Canada's highly qualified manpower is employed in occupations where corresponding educational output targets are only loosely linked with general social and economic aspirations (e.g. physicians per head of population), rather than in fields where more specific production targets are set (e.g. lab technologists in a chemical plant). In the former areas, the manpower requirements are determined largely by public decisions about such factors as the desired standards of medical service, the extent to which certified lawyers will be required for officiating in business transactions, the volume and direction of scientific research, etc. These decisions are generally made, at least in part, by centralized bodies with strong representation from experts in the relevant technical field. Such bodies are likely to have good knowledge of the current state of qualified manpower in the field, and the decisions about the projects to be undertaken are not independent of the information about the available manpower. A known abundance of highly trained manpower can be a positive influence on decisions about social programs, and a known shortage can be a negative influence. In these sectors of the economy, manpower requirements can be estimated only on the basis of certain assumptions about the willingness of the public to support certain social programs, the standards of performance in activities where output is usually difficult to measure, and the organizational structure.

2. Hansen's neoclassical manpower requirements

Most people who have written anything at all in the area of manpower planning have produced some kind of definition of manpower requirements. Most of these definitions are quite similar to that discussed above, i.e. some minimum number of qualified persons necessary to achieve given economic and social targets.

W. Lee Hansen (1965) has analyzed manpower requirements and manpower projections from a much wider point of view, and given alternative definitions. His classification of different types of manpower projections which helps considerably to clarify the meaning and usefulness of such projections will be discussed later in Chapter VI.

Hansen's framework for analyzing the concept of manpower requirements is essentially neoclassical, as compared to the implicit Leontief assumption upon which the definitions are usually based. The Hansen framework is neoclassical in that it assumes that there is price flexibility and that relative supplies and demands of different types of labour affect and are affected by relative prices and wages. His first definition of manpower requirements is in terms of the numbers of workers in different fields needed to maintain the existing pattern of earnings differentials. It is assumed that most, if not all, of the new graduates will be hired, but possibly at the expense of driving down relative wages (i.e. wage

flexibility). For example, there is some ratio of engineering to technology graduates for which the current ratio of engineers' to technologists' wages would remain unchanged ($R_w$). If the actual ratio of graduates exceeds $R_w$, then engineers' earnings would probably fall relative to technologists' wages.[3]

The principle underlying this definition--the effect of incremental supplies upon the earnings structure--is also the basis of Hansen's other definitions of manpower requirements: the number of workers needed to maintain the existing pattern of rates-of-return to training in different occupations, and the numbers of workers needed to equalize rates-of-return in different occupations. These are meaningful definitions in a neoclassical world. They provide policy-makers a wide range of choices. In fact, in such a world, manpower requirements can be defined only in some way such as this, for the given economic and social targets can be achieved in a variety of ways. However, the definitions obviously are not useful in a world of Leontief production functions, or in the absence of wage flexibility, where incremental changes in the supplies of qualified manpower are not accompanied by changes in the structure of earnings.

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[3]On the basis of casual observation, the ratio of starting salaries of engineers and technologists does not appear to be very sensitive to the ratio of current numbers of graduates in the two fields (Skolnik and McMullen, 1970: 63-64).

B. General Overview of Methods of Manpower Projections

There have been a number of good surveys and critiques of the methodology for making projections of manpower requirements (Parnes, 1962; Hollister, 1964; Emmerij and Thias, 1966; Meltz, 1965; Mehmet, 1965; Bombach, 1964). It would be a misplaced expenditure of effort for us to attempt to duplicate these surveys. Rather than giving detailed descriptions of all of the projection models in use, we shall give a general summary of the basic principles common to most of the models, point out the main variants of the basic model, and make a number of observations about the implicit aims of various methodologies.

1. What is being projected?

There have been no projections of manpower requirements made explicitly in terms of the neoclassical definitions put forward by Hansen. Rarely, in fact, have authors of projection studies defined the type of projection they were making.[4] Most studies appear to project the quantities of different types of educated manpower believed to be required for a projected level and

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[4]An exception is the Watson-Butorac study (1968). The projections are "estimates of the numbers and types of manpower we might reasonably need in the normal course of events in an unplanned economy, striving for sustained economic growth very loosely defined within certain general guidelines" (p. xvii). The authors distinguish between projection and forecast, the latter "a prediction subject to the achievement of a certain target, that is, . . . a statement of intent, of what will happen when the economy is manipulated in a given way to achieve a certain goal" (p. xvii).

composition of GNP. These studies seem to rest upon an implicitly assumed Leontief production model, although many of the authors might resist the rigid interpretation of that model.

If one considers any flexibility in the economy, then one accepts that the existing level and composition of GNP could have been produced using a different occupational mix than presently exists. Faced with alternative feasible occupational compositions, it is logical to attempt to define (according to various criteria) an optimal occupational mix for the present and project the optimal mix for the future. Few projection studies have given any attention to determining the optimal distribution of qualified manpower for the present or past.[5] Nearly all have extrapolated, by one means or another, the past and present observed distributions into the future. This implies that the authors have either (a) assumed that there was a unique occupational distribution feasible at a given point in time, i.e. the extreme Leontief assumption; or (b) in their projections, implicitly selected one of many

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[5] Meltz (1968) attempted to allow "for the cyclical sensitivity of industries' occupation structures of employment" by using the percentage occupation structure of the labour force in each industry as a proxy for the cyclically adjusted occupation structure of employment in the industry (p. 15). While this approach helps to eliminate cyclical variability, neither the actual occupation structure of employment or of the labour force could be defined as an optimal occupation structure according to specified optimality criteria.

feasible sets of manpower requirements on the assumption of certain unspecified conditions similar to those which held in the past. If the past occupational distributions were non-optimal according to most sensible optimality criteria, then the sub-optimality likely will be projected into the future.

2. <u>The cross-section approach</u>

One way to classify manpower projections is to group them dichotomously as those analyzing time-series data in one jurisdiction and those analyzing data across jurisdictions for the same point in time. In the former, the future manpower requirements for a country are projected mainly from historical manpower data for that country. In the latter approach, the future manpower requirements for a given country are projected mainly on the basis of historical and current manpower data from other countries.

The cross-national approach has been recommended in the case of countries at a relatively early stage of economic development (Harbison and Myers, 1964). Two reasons for this approach are that such countries usually have poor historical data, and they are frequently committed to policies for major structural transformations of the economy and society. Such transformations would make for discontinuity between past and future to the extent that extrapolation of time-series data would be (hopefully) misleading. Such structural trans-

formation may make the economies of those nations more like those of western (i.e. industralized) states. Political conditions may or may not allow the articulation of such a goal.

This approach has been roundly criticized (especially Sen, 1966; Blaug, 1970). The critics note that it ignores a variety of cultural, institutional, and geographical differences among countries at similar levels of economic development. It smacks of cultural and institutional imperialism, especially when some western country is put forward as a propotype for an emerging nation. It neglects the time element in the historical process, as, for example, when proper emphasis is not given to the environmental differences between a western nation of the nineteenth century and an industrializing nation with the same per-capita income in the middle of the twentieth century.

Applying this approach in Ontario would encounter the further difficulty that there are no economies in the world notably more advanced upon whose experience Ontario's future might be predicted. One does hear casual remarks relating certain current economic, social, and political phenomena in Ontario to similar developments in British Columbia, California or New York a few years ago, but it has yet to be demonstrated that this is a feasible approach to social and economic forecasting for Ontario. It would be naive and politically absurd to link Ontario occupational forecasts to the experience of other jurisdictions in even a mildly deterministic model.

Whatever the objections to deterministic national forecasting models, however, cross-jurisdictional data can be valuable. One can achieve a great deal of understanding of the role of educated manpower in the economy through attempting to explain the reasons for international variation in occupational distributions (cf. Layard and Saigal, 1966). Similarly, international comparisons may provide good clues to the occurrence of sub-optimal patterns of manpower utilization. R. G. Hollister has shown that Spain used a considerably larger number of highly trained workers per unit of output in manufacturing than Portugal, and yet Spain's productivity in manufacturing was less than Portugal's. This does not prove that Spain was misallocating its skilled manpower, but it does suggest the need for further analysis (Hollister, 1967: 48-52). In addition, comparison of projected manpower requirements for one jurisdiction with current actual manpower stocks for other states may provide some rough check on projections. If one's projected requirements of engineers for Antigua for 1980 were (on a per capita basis) three times the actual number for the U.S. in 1970, this would at least justify going back through the arithmetic to see if somewhere along the way a decimal point might have been put in the wrong place.

3. Time-series projections

Although there is a great variety of time-series models for use in projecting manpower requirements, they are notably

similar. It is most convenient to describe first the approach used by Noah Meltz and G. Peter Penz (1968) in their work for the Canada Department of Manpower and Immigration, and then point out principal variants from this basic methodology. The Meltz-Penz study is a good example of the state of the art of manpower forecasting. As such it is heuristically justifiable to examine its components.

The main steps[6] in the Meltz-Penz study were to:

a) project population by age and sex allowing for immigration and emigration;
b) project age-sex-specific labour-force participation rates;
c) apply the projected participation rates to the projected population figures to obtain projections of the labour force;
d) apply the target employment rate of 97 per cent to the labour-force projections to obtain employment projections;
e) project employment in agriculture from the post-war trend in agricultural employment;
f) Project employment in public administration by projecting output and output per worker in that sector;
g) project employment in community service by projecting output, output per man-hour, and average hours per worker in that sector;

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[6]For steps (a)-(h) Meltz and Penz used earlier work of the Economic Council of Canada, which they cite (1968: 4-6).

h) project employment in the commercial non-agricultural sector as the difference between (d) and the sum of (e), (f), and (g), i.e. the residual;

i) project the distribution of commercial non-agricultural employment by industry by extrapolating trends, adjusted for cyclical variation, in the overall unemployment rate;

j) within each industry, project the occupational distribution of employment by extrapolating trends in the occupational structure of the labour force in each industry;

k) sum (j) over all commercial non-agricultural industries to obtain a projection of the total distribution of employment by occupational group;

l) project by extrapolation the distribution of levels of educational attainment by occupation;

m) apply the projection in (l) to that of (k) to obtain projections of the educational structure by occupation;

n) sum the educational structure in (m) over all occupations to obtain projections of the required numbers by type and level of education for the target year;

o) project attrition by type and level of educational attainment;

or, alternatively, after (k)

l') project attrition by occupational group;

m') subtract (l') from (k) to obtain projections of the required inflow of manpower by occupational group;

n') estimate through survey the optimal educational qualifications of new entrants into each occupation;

o') apply the educational requirements of (n') to the required manpower inflow by occupation (m') to obtain the distribution of required new entrants in each occupational group by type and level of education;

p') sum (o') over all occupations to obtain projections of the total required inflow of manpower by type and level of educational attainment;

and then, in either case,

q) project the part of the required inflow of educated manpower that must come from the domestic educational system rather than from immigration.

Three points should be noted now about the Meltz-Penz study.[7] First, most of the projections of various components were made by graphical extrapolations or simple linear regressions. Secondly, the two variants of projecting the occupation-education relationship, (l)-(p) and (l')-(p'), were defined according to different dimensions of educational attainment, with the latter being more disaggregative, extensive, and subjective. Thirdly, step (q) was not actually undertaken.

4. <u>Variants of the basic methodology</u>

a) <u>the output-productivity method of projecting aggregate</u>

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[7]Other points about this study will be made later in subsequent sections of this chapter.

employment: An alternative to projecting aggregate employment by applying a target rate of employment to the labour force projection is to project aggregate output (GNP) and productivity, and divide the former by the latter to obtain the projected aggregate employment. Having done this, and projected the labour force, it is possible to calculate an implicit rate of unemployment. One advantage of this approach is that the manpower planner need not be tied to an assumption about the level of unemployment in the target year.[8] While this might be avoided by simulating the effects of various unemployment rates, there is no basis for choosing one estimate of the unemployment rate over another, without projections of output and productivity. Sometimes, input-output models have been used for projecting output by industry (Burtie, 1952). A major problem here is that making reasonably accurate projections of aggregate output and productivity is not an easy task.

To quote Hollister (1967: 31):

> . . . output per worker is one of the most serious problems to be dealt with in constructing manpower projections related to economic output. The fact that these estimates are likely to be a source of significant error in such projections is suggested by analysis of

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[8] Meltz and Penz assumed 3 per cent unemployment in the target year--1970.

> past productivity trends. Studies show that the advance of productivity is quite irregular both over time and among economic sectors. These irregularities have not been convincingly linked to any secondary factors. For this reason, it must be presumed, at present, that it is not likely that estimates of future productivity levels will be accurate.

Generally, the output-productivity method is applied at the level of the industry rather than at the aggregate level (e.g. Ahamad, 1970).

b) projecting employment directly by industry: In the Meltz-Penz study, projections of employment by industry were derived from the projections of aggregate employment by applying intermediate projections of the percentage distribution of employment by industry. Alternatively, one can forecast employment separately for each industry, and then sum to obtain the projection of total employment. The issue in this case is not whether simple extrapolation of industry employment is better than output-productivity projections, but rather how the sum of the industry projections compares with the projection of the sums. This is a problem which occurs throughout manpower projection work, e.g. in projecting output by industry or employment by occupational category. In Part B of this study, we use a method of constrained estimation in which projections of output for each industry are modified in a systematic

manner to make them consistent with the projections of aggregate output. In most previous studies, the approach has been to go back and make _ad hoc_ adjustments of industry totals to reconcile them with the aggregate projection.

c) _occupational co-efficients_: An alternative to projecting the percentage occupational distribution by industry is to use the relationship between the output of the industry and the numbers of people in a given occupational category employed in that industry. The ratio of the number of people employed in a given occupation to the output of the industry is often referred to as the occupational co-efficient for the industry. One of the advantages of projecting occupational co-efficients rather than the occupational distribution is that the former may be less sensitive to cyclical fluctuations in the state of the economy. The number of engineers employed per ton of steel output is not affected by the general absorption and releasing of unskilled labour in the economy to the same extent as is the ratio of engineers to total employment. Relating occupational projections by industry directly to industrial output is more in keeping with the concept of manpower requirements than is the occupational distribution approach.

There are three problems in working with occupational co-efficients. The occupational requirements are projected separately for each industry, and there arises the difficulty

of reconciling the sum of industry projections of aggregate employment. It is often impossible to obtain output data that is commensurate with employment data, since these types of data generally are collected by different agencies using different samples and/or classification systems. A great amount of tedious work is usually necessary in order to make the two types of data commensurate and estimate the occupational co-efficients. Even more disconcerting is the fact that occupational co-efficients have been shown to be unstable over time, and to vary between countries with similar economic conditions (Moser and Layard, 1964: 296). Hollister has demonstrated substantial variation in occupational co-efficients for most industries among the Mediterranean Regional Project countries, and he has speculated at length on the possible sources of the variation (1967: 48-51). Nevertheless, the occupational co-efficient approach is considered preferable to the occupational distribution approach, by Hollister and by the authors of this report. It is used as far as is possible in making the projections of manpower requirements in Part B.

d) omitting the occupational link: Most people who have written on manpower forecasting agree that the occupation-education relationship is the weakest link in the chain connecting industrial output to educational requirements (e.g. Hollister, 1967: 38). In Canada, as elsewhere, there is great variance in the years of schooling of people within

most occupational categories (Meltz, 1968: 25; Parnes, 1962: 112-13). This is true particularly for occupations where the educational preparation is not stipulated by law or stringent certification regulations (such as in medicine, law, teaching). The variance is greatest in newly emerging occupations where the corresponding educational curriculum has not yet been formalized, e.g. technologists and technicians (see Tracz, Skolnik, and O'Mahony, 1971: 16-19).

In such occupations, trend projections of the distribution of levels of educational attainment seem unsatisfactory because many of the workers may have obtained their positions in the past in spite of their level of education rather than because of it. An alternative is to specify what employers and vocational experts consider to be the most desirable qualifications for new entrants into the occupation. This approach has several advantages.

It permits a finer degree of disaggregation by occupational category than most census data on educational attainment provide. It allows for a more detailed educational classification than simple years-of-schooling, which is generally all that is available in the censuses. In using this method Meltz (1968) considered technical and commercial high schools, apprenticeship, and systematic on-the-job training. Also, it helps to overcome the problems related to substitution. The variance in educational attainment for a given occupation indicates that it is possible to fill a given occupational

role with a variety of educational inputs, without affecting productivity. The observed educational distribution within occupations is thus influenced by the supplies of educated manpower as well as by the characteristics of the job. In this sense the observed patterns reflect *ex post* educational substitution possibilities. The *ex post* substitution possibilities are not reflected in the employers' specifications of the desired qualifications for particular occupations, but *ex ante* substitution possibilities may affect the specifications insofar as the employers are influenced by their perceptions of the supplies of educated manpower.

In spite of these advantages, the second method has often been criticized for relying on "soft data", and the manpower forecasting literature places more emphasis on analysis of census data about educational attainment. We agree with Blaug (1970: 154-157) that there has been too much emphasis on census data of doubtful validity, and insufficient attention given to job analysis and job specification. With whatever reservations, most forecasters have had to rely at least in part on soft data or judgement in projecting the educational requirements for occupations.[9] Meltz presented two separate sets of projections of educational requirements, one based on

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[9] For a summary of the somewhat arbitrary assumptions made in converting occupational requirements into educational requirements in the Mediterranean Regional Project, see Hollister (1967: 93-95).

extrapolation of census data, the other based on judgement about educational qualifications for new entrants into each occupational category.

There are two fundamental objections to including the occupational link in a manpower requirements forecasting model. The first, as discussed above, is that no stable relationship between occupation and educational attainment has been discovered, and "knowledge about the factors affecting the relationship between occupations and educational requirements is still extremely rudimentary" (Hollister, 1967: 38). The second objection is that the occupational classification systems which have been devised are unsatisfactory for the purposes of manpower forecasting. The problems of occupational classification will be discussed in the following section.

One response to the dissatisfaction with the occupational link between production and educational requirements is to omit the occupational link, and relate educational requirements directly to production. A well-known model which does this is that of Correa-Tinbergen-Bos (Correa, 1963: Chapter 14; Correa and Tinbergen, 1962; Tinbergen and Bos, 1965) which for its role in the historical development of manpower requirements models is worth a short summary.

e) <u>the Tinbergen-Bos-Correa model</u>: The basic assumption of these models is that there is a fixed relationship between units of national income and the stock of educated manpower.

The model is highly aggregative, and its attractiveness lies in its simplicity. In the first model (Correa and Tinbergen, 1962), national income was not broken down by sector, and in neither model was the labour force broken down by occupation, but only by three levels of education. The requirement for people with the second level of education is assumed to be directly proportional to national income. Part of the requirement for people with the third level of education also is assumed to be directly proportional to national income. The other component of the total requirement for people with the third level of education is teaching at the second and third levels, assumed proportional to the number of students at those levels.

In addition to the manpower requirements the model also contains supply equations. The stock of second- and third-level manpower in the current period is equal to the stock in the previous period plus new entrants (who have just completed the first and second levels, respectively) minus deaths and retirements from the labour force (assumed to be a constant proportion of the previous period's stock).

With this framework, the authors were able to examine the manpower implications of a number of different growth paths for an economy. For a given rate of economic growth it is possible to deduce the annual requirements for second- and third-level manpower in order to avoid shortages and surpluses.

The authors show also how the rate of growth of the economy can be accelerated by using foreign aid in the form of trained manpower--assuming that educated manpower is a bottleneck. They show alternatively how the growth rate can be accelerated without foreign aid by raising the student-teacher ratio or reducing the requirements of educated manpower per unit of output. They do not speculate on the actual feasibility of varying unit manpower requirements.

Within its authors' fixed requirement framework the model is very general, and a number of extensions are considered in the second article (Tinbergen and Bos, 1965). These include disaggregating by industrial sector, introducing more stages into the educational process, and considering alternative demand-for-manpower equations--but still only equations with fixed requirements, i.e. with manpower requirements depending on the level of output and per-capita income.

The model gives a simple but illuminating view of the interconnections of manpower flows through the system. The value of the model for long-term forecasting depends upon the validity of the postulated relationship between manpower requirements and national income. No justification is given for the particular relationships assumed. This is unfortunate, since the major objective of the model is to "help solve some quantitative long-term educational planning problems" (1965: 95). Unless there is reason to believe that the forecasts of

manpower requirements are reasonably accurate, the model will be of little help in long-term planning.

The evidence from international cross-section analysis of the relationship between the stock of educated manpower and the level of GNP, or other economic indicators, does not justify much confidence in the use of this relationship to forecast manpower requirements (Horowitz, *et al*, 1966; Layard and Saigal, 1966). While they present their results with extreme caution, Layard and Saigal note that "the relationship of output per worker to occupational structure is closer than to educational structure" (1966: 249).

If Layard and Saigal are correct, their findings are a justification for maintaining the output/occupational link. Another reason for doing so is that the educational preparation for most highly qualified manpower is quite specialized, and educational planning cannot be based on such highly aggregative categories as secondary and tertiary education. When we begin to consider a finer breakdown of the post-secondary sector by type of education, we come near to dealing with occupational groups. In fact, some manpower experts have proposed to define occupation by education (Debeauvais, 1963: 87-88). We believe that there are good reasons for maintaining the two-stage (occupation-education) approach, as will be discussed in the following section. If manpower forecasting is going to become more reliable (which is not a certainty

in any case), it will be only after sustained efforts at producing appropriate occupational classification systems and continuing analysis of the relationship between occupation and education. It seems most inauspicious to ignore the occupational link.

C. Occupational Classification

An occupational classification system attempts to arrange the millions of jobs in the economy into a small number of sub-groups--about one dozen at the highest level of aggregation in the 1961 Census of Canada, and about 200 at the most detailed level. The most recent edition of the Dictionary of Occupational Titles (hereafter DOT) in the United States (U.S. Department of Labor, 1965) listed over 35,000 specific occupational titles and defined about 20,000 titles. Obviously, partitioning millions of jobs into a relatively small number of sub-sets can be done in a number of ways, and there has been a considerable amount of controversy as to what is the best way. Nevertheless, many observers (e.g. Blaug, 1970: 153-159) are of the opinion that none of the existing classification systems are very useful for the purposes of manpower forecasting.

1. Approaches to defining occupations

In general there are two main approaches to defining occupations: the "functional" and the "educational" approaches. In the first, the definition consists of a description of the duties performed. The latter consists of a synopsis of the

education (mainly formal) thought necessary to carry out these duties. In practice, most occupational definitions embody some elements of both.

The best definition, of course, depends upon the purpose at hand. In a manpower planning context, the functional definition is clearly preferable. It is assumed that certain identifiable work functions must be performed, that these functions can be grouped into sets of related tasks, and that these sets define an occupation. No doubt, the nature of each set can be varied somewhat in accordance with the personnel available, subject to institutional and technological constraints. The essential problem of manpower planning is determining the number of workers required in each occupation. This approach to manpower planning invites questions about the quantity and types of education necessary for specific occupations. An occupational definition may, however, contain in addition to its functional elements a description of the education and/or training common to its practitioners.

The chief limitation of a purely educational definition is the propensity of people with the same level and type of education to hold quite different jobs. For example, a purely educational definition of civil engineering might be "the position filled by someone with a B.Sc. in Civil Engineering." Since B.Sc. graduates in Civil Engineering are found in a great variety of lines of work, this is not a very precise

description of this occupation. There is little satisfaction in a definition that says nothing about duties and functions, e.g. designs roads, calculates the maximum stress capacity of bridges, etc.

Furthermore, to define an occupation solely in terms of educational attainment precludes asking questions about the optimum utilization of educated manpower. To take Blaug's example (1970: 154), if engineering is defined as any job held by someone with a degree in engineering, questions about the efficiency of having engineers working as technicians will never arise; they are precluded by definition.

2. Functional definitions: general and particular

The functional approach to occupational definition has one major drawback. It may be extremely complicated and lead to a situation where there must be either a multiplicity of descriptions of related types of work, comprising a family of occupational titles, or an intricately detailed general statement which attempts to cover all possible variations, but which is usually too cumbersome to be of any value.

The duties of the scientist or engineer vary considerably between industries, between levels of production, and between types of technology and organization. Accordingly, the definitions of the occupations may be general or particular. The purpose of the former is to convey a broad impression of the features of this type of work which are common to most

situations, while the purpose of the latter is to provide a more precise description of the functional requirements under particular circumstances.

The general definition may be very short and simple, perhaps a single sentence, or it may be an intricately detailed statement designed to cover all possible situations. Some writers have argued that very short general definitions are sufficient, since a comprehensive all-inclusive definition would be "too cumbersome for general use" (Young, 1965: 5). J. T. Young has proposed the definition of the technician as "a person expert in applying specific proven techniques associated with science or technology; in particular, one who has undergone a systematic course of instruction related to those techniques." This tells us so little about the work functions of the technician that it may be inadequate to its main purpose, job identification or classification.[10]

3. Occupational definition and classification: technicians

A difficult occupational group to define and classify is that of science and engineering technicians. It contains newly emerging occupations, the products of changes in technology for which the specifications are still evolving. By nature, the occupational roles are marginal to engineering and the trades, embodying to indeterminate degrees elements of each

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[10] For a discussion of the problems of counting the number of technicians in Ontario, see Skolnik and Bryce, 1971: 50-56.

(Evan, 1965). Because of these difficulties, it is an interesting set of occupations to discuss in connection with the most widely used occupational classification systems.

The occupations in this group are of especial interest in Ontario. Much of the rationale for the system of Colleges of Applied Arts and Technology was the supposed shortage of science and engineering technicians in Ontario and/or a too heavy reliance on immigration for meeting these manpower needs (Ontario Legislature Committee on Manpower Training, 1962). Initially, the Colleges of Applied Arts and Technology were strongly oriented toward the science and engineering technology programs. Moreover, many of the Business and Applied Arts programs train the equivalents of technologists and technicians in these fields. By analogy, it is to be expected that there will be problems of occupational classification in Business and Applied Arts similar to those in science and engineering.

a) <u>the International Standard definition</u>: The short definition given by Young tells little about the kind of work in which technicians engage, and is of little assistance in distinguishing between technicians and professional engineers, on the one

hand, and technicians and craftsmen on the other.[11] A more exacting definition which overcomes some of these difficulties is that given in the International Standard Classification of Occupations (International Labour Organization, 1958). The ISCO divides occupations into nine major groups, of which the first, Group O, is "Professional, Technical, and Related Workers." This group is divided into a number of sub-groups, one of which is O.X, "Draughtsmen and Science and Engineering Technicians, not elsewhere classified." There are two occupations listed under O.X: "Draughtsmen", O.X1, and "science and engineering technicians, n.e.c.," O.X9. At the most detailed level, three occupational titles for engineering and science technicians are given--

O.X9.20 Technician (Engineering)

O.X9.30 Technician (Research Laboratory)

O.X9.40 Technician (Industrial Laboratory)

The definition of Technician (Engineering) is:

> Performs one or more technical tasks, usually under the direction and supervision of a professional engineer in civil, electrical, mechanical, chemical, mining or other branch of engineering; prepares sketches and plans

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[11] One hesitates to criticize Young's definition since he prefaced it by saying that "to attempt another definition of a 'technician' today is to invite criticism from almost every quarter and to invoke invidious comparison with other more exact and exhaustive pronouncements" (1965: 8).

> relating to engineering work as directed, or gives technical guidance to draughtsmen; calculates gear ratios, pressures, temperatures and similar factors relating to project in hand; prepares estimates of materials and costs; assists professional engineers in planning and supervision of manufacturing processes, construction work and the preparation of work schedules; tests and examines engineering products, plant or structures; supervises engineering maintenance and repair work; performs other technical tasks in engineering. Usually specialises in a particular field of engineering (ISCO, 1958: 49).

This definition gives a good idea of the type of work done by engineering technicians, and the other two definitions do as well for the other types of technician work. For general purposes of information, these definitions may be adequate. However, these definitions fail to satisfy certain other purposes. In particular they provide no information on different levels of work within this broad occupational category, e.g. from the least sophisticated and demanding to the most. Secondly, the definitions give little indication of the great variety of specific types of specializations, although they do suggest that within each of the three broad definitions

specialization is likely.[12] This type of information is useful for several reasons. In vocational guidance it may be used to provide youngsters with some idea of the range of opportunities associated with a career or training choice. In planning for the education and training of technicians, it is necessary to have some idea of the numbers of technicians required in total, and in various specializations if there are substantial differences in the education and training needed for those specializations. Since industrial workers tend to be identified by fairly specific job titles, the mere counting of the science and engineering technicians may require a knowledge of the specific job titles of technicians.

b) technicians in the Dictionary of Occupational Titles: The Dictionary of Occupational Titles (DOT) is the most comprehensive compendium of occupational titles. Unlike the ISCO, the DOT contains no general entry for science and engineering technicians. Among the more than 35,000 occupational titles defined, there are perhaps 150 which might be classified under the general heading of science and engineering technicians.

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[12] The latest edition of the International Standard Classification of Occupations (1968) defines eight types of engineering technicians, e.g. chemical, electrical, mechanical, etc. The numbering system differs somewhat from the 1958 Classification. We have described the 1958 Classification above because it rather than the later version (which got into widespread circulation only by mid-1970) is the basis for most international projections of manpower requirements.

To use the DOT as a basis for counting the number of science and engineering technicians is not an easy task: one must sift through large sections of the DOT, looking at particular job descriptions and deciding whether to include various titles under this general heading. This is an exhausting and sometimes arbitrary task, but the best way of defining and enumerating the group called science and engineering technicians.

Working with the DOT reminds one that an occupational title or definition is a rather artificial construct, and arranging titles into groups is a messy business. Ideally one should probably look at every job in the economy and decide whether to include it or exclude it from a particular group in question. The DOT makes this job much simpler by having already sifted through the millions of jobs and grouped them into 21,741 basic categories (which contain another 13,809 related titles for which definitions are also given, bringing the total number of definitions to 35,550). The task then is to select from these 21,741 categories the titles which comprise the general group of science and engineering technicians.

How does one locate the science and engineering technician titles in the DOT? To start with, one can search for such obvious titles as "mechanical engineering technician" or "electrical engineering technician". There are two problems with this approach. First, it may lead to the exclusion of

a number of titles which should be included. Many titles for engineering technician do not contain the word "engineering" or "technician". For example, while the DOT contains an entry for "mechanical engineering technician" (007.181), there is no such title as "electrical engineering technician". The closest title to the latter is "electrical technician" (003.181). Moreover, under the same base number (002.281) as "chemical laboratory technician" there are also such titles as "assayer, water purification chemist, physical tester, and malt specifications control assistant." If the former is to be counted as a science technician, then so should the latter four titles. Again, as will be seen in more detail below, the Occupational Classification Manual for the 1961 Census of Canada (Dominion Bureau of Statistics, 1961) lists over 170 specific occupational titles for science and engineering technician, and the majority of titles do not contain the word "technician". One is not likely, therefore, to collect all the titles sought merely by collecting those containing the words "technician" or "engineering", "chemical", or "metallurgical", etc.

Conversely, some titles which contain the word "technician" may not be appropriate for inclusion. Since our main concern is with science and engineering technicians, those technicians in other fields should not be included, e.g. museum technicians, teaching technicians, etc. Even with the engineering

and scientific fields, the word has an enormous variety of meanings. This can be illustrated by the following example. The DOT lists an "electronic technician" (003.181) and an "electronics technician" (726.281). In spite of the similarity of these titles, it is clear from the following definitions, that the respective functional contents differ considerably.

Electronics Technician (726.281)

Tests and repairs electronic components of automated production lines that produce deposited carbon resistors for use in electronic equipment, such as missile control systems. Starts electronic units that control production machines and observes monitoring graphs and gages to verify operation of machines along automated line. Types program onto punch tape following coded production order. Inserts punch tape into reader that types data on data sheet and transmits data to magnetic memory drum of digital computer. Compares typed data sheet with coded production order to verify information transferred to memory drum. Starts computer's output and input circuits to set up production machines according to program and close loop to affect feedback of data. Starts conveyors and machines and observes feedback data sheet, monitoring graphs, and gages to detect malfunctions in automated processing machinery and electronic equipment.

Tests electronic circuits and analyzes data to isolate malfunctions, using oscilloscope, synchroscope, oscillators, galvanometer, voltmeter, and calibration charts, following schematic and wire diagram. Repairs equipment by rewiring components, soldering loose connections, and replacing parts, such as coils, condensors, tubes, and resistors, using such handtools as pliers, screwdriver, tweezers, wirecutters, soldering iron, and knife. Adjusts circuit variables and calibrates and alines control according to calibration charts and graphs. (DOT, 1965: Vol. II, 246).

Electronic Technician (003.181):

Applies electronic theory, principles of electrical circuits, electrical testing procedures, engineering mathematics, physics, and related subjects to layout, build, test, troubleshoot, repair, and modify developmental and production electronic equipment, such as computers, missile-control instrumentation, and machine tool numerical controls. Discusses layout and assembly problems with Electronic Engineer and draws sketches to clarify design details and functional criteria of electronic units. Assembles experimental circuitry (breadboard) or complete prototype model according to engineering instructions, technical manuals, and knowledge of electronic systems and components and their functions.

Recommends changes in circuitry or installation specifications to simplify assembly and maintenance. Sets up standard test apparatus or contrives test equipment and circuitry, and conducts functional, operational, environmental, and life test to evaluate performance, and reliability of prototype of production model. Analyzes and interprets test data. Adjusts, calibrates, alines, and modifies circuity and components and records effects on unit performance. Writes technical reports and develops charts, graphs, and schematics to describe and illustrate systems operating characteristics, malfunctions, deviations from design specifications, and functional limitations for consideration by professional engineering personnel in broader determinations affecting systems design and laboratory procedures. May operate bench lathes, drills, and other machine tools to fabricate non-procurable items, such as coils, terminal boards, and chassis. May check out newly installed equipment in airplanes, ships, and structures to evaluate system performance under actual operating conditions. May instruct and supervise lower grade technical personnel. May be designated according to specialization in electronic applications as Computer-Laboratory Technician; Development Instrumentation Technician; Electronic-Communications Technician; Electronic Technician, Nuclear Reactor. (DOT, 1965: Vol. II, 246).

It is clear that the electronic technician functions require a higher level of theoretical knowledge and offer greater scope for judgment and inventiveness than do those of the electronics technician. The job specification of the former included applying theory, developing new designs and procedures, writing technical reports, and interacting with professional engineers; while the functions of the latter involve mainly carrying out well-defined operations and procedures. It is evident that one of these job titles does not belong in the category of science and engineering technician; or, if both are to be included, there ought to be some distinction within the category concerning level of skill, knowledge, or responsibility.

The electronic technician (003.181) should definitely be included in the category of science and engineering technician. The question is whether to include also the electronics technician. One answer is suggested by looking at the code numbers of the different job titles. A digression on the meaning of code numbers in the DOT and their use in elucidating definitions seems justified, since this is the most comprehensive effort ever made to classify and define occupations.

i) the meaning of code numbers in the DOT: The DOT contains a detailed explanation of the code numbers, and here we wish to make only a few relevant points. The numbers to the left of the decimal indicate the occupational categories, which

are distinguished according to "work field, purpose, material, product, subject matter, service, generic term, and/or industry" (DOT, 1965: Vol. I, xvii). There are eight major categories identified by the first digit, as shown below:

One-Digit Occupational Categories
in the
Dictionary of Occupational Titles

| | |
|---|---|
| 0)<br>1) | Professional, technical, and managerial occupations |
| 2 | Clerical and sales occupations |
| 3 | Service occupations |
| 4 | Farming, fishery, forestry, and related occupations |
| 5 | Processing occupations |
| 6 | Machine trades occupations |
| 7 | Bench work occupations |
| 8 | Structural work occupations |
| 9 | Miscellaneous occupations |

These categories are further divided into 84 two-digit groups, which are, in turn, broken down to 603 three-digit groups. For example, in the first major category, the two-digit divisions are based on broad subject matter, e.g., 00 and 01 architecture and engineering, 02 mathematics and physical sciences. In the bench work occupations, the two-digit divisions refer to areas of work, e.g. 72 assembly and repair of electrical equipment. The three-digit designation

is, of course, more specific, i.e., 003 electrical engineering, 007 mechanical engineering, and 788, occupations in fabrication and repair of footwear.

The three digits to the right of the decimal indicate the functional relationship to data, people, and things for the particular job. These digits are based on research findings of the U.S. Employment Service (summarized in Fine, 1968). These relationships are defined in the form of a hierarchy from the complex to the simple. The code is given on the following page.

ii) identifying code numbers for technicians: The code number for the electrical and mechanical engineering technicians, respectively, are 003.181 and 007.181. The first two digits indicate that the job is defined as being "professional, technical, and managerial work", and within that category, engineering work. The third digit indicates the type of engineering. The next three digits indicate that this work involves (a) co-ordinating data, (b) "no significant relationship" to people,[13] and (c) precision working with things. If this definition is accepted for these specific types of engineering technician titles, then one might ask if all job titles which end in .181, and only

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[13] The numeral 8 signifies that the relationship which the job requires of the worker is "not significant within a particular hierarchy" (our emphasis). See DOT, 3rd ed., 1965, Vol. I: xviii.

## EXPLANATION OF SUFFIX CODE NUMBERS USED IN DICTIONARY OF OCCUPATIONAL TITLES

| | Relationship to DATA (4th Digit) | Relationship to PEOPLE (5th Digit) | Relationship to THINGS (6th Digit) |
|---|---|---|---|
| 0 | Synthesizing | Mentoring | Setting-Up |
| 1 | Co-Ordinating | Negotiating | Precision Working |
| 2 | Analyzing | Instructing | Operating-Controlling |
| 3 | Compiling | Supervising | Driving-Operating |
| 4 | Computing | Diverting | Manipulating |
| 5 | Copying | Persuading | Tending |
| 6 | Comparing | Speaking-Signalling | Feeding-Offbearing |
| 7 | No Significant Relationship[1] | Serving | Handling |
| 8 | | No Significant Relationship[1] | No Significant Relationship[1] |

Source: Dictionary of Occupational Titles, 3rd ed., 1965, Vol. I, xviii.

[1]The numeral 8 signifies that the relationship which the job requires of the worker is not significant within a particular hierarchy. Whenever a worker's involvement in the THINGS hierarchy is at the 0, 1, or 2 level, and there is no significant relationship to DATA, the digit 7 is used in the DATA hierarchy instead of the digit 8.

those titles, should be included in the "science and engineering technician" category.

This would not be a useful rule of thumb, since the code number for pharmacist is 074.181 and quality-control technician is 019.281. The former should not be included in the science and engineering technician category, while the latter should; so, in general, having .181 for the last three digits is neither a necessary nor sufficient condition for inclusion.

There is no short cut to compiling the list of specific job titles which should be included in the broad category of science and engineering technician. However, when one goes through the DOT in this endeavour, the appropriate job titles seem to cluster around a few code numbers. All of these end in .181, .281, and occasionally .381. It is difficult to find job descriptions at all similar to the "undisputed" definitions (e.g. "mechanical engineering technician") that have other suffixes. Nearly all of the job titles ending in these suffixes are in three DOT "families": "drafting and related work," "technical work, engineering and related fields," and "materials analysis and related work." A substantial number of titles are included in the "drafting and related work" family, and whether to include drafting and surveying work in the general category of technnician is open to question. As Watson and Butorac (1968: 98)

have pointed out, "in the hierarchy of industry, draftsmen generally fit into the technician-technologist level, and their number has grown at least as fast as the technicians." Some "mechanical engineering technicians" may actually spend more time in drafting than "mechanical drafting technicians."

The "materials analysis and related work" family is about as large as the drafting family. It is clear from inspecting the job definitions that most of the titles in this family should be included in the technician category, but some are probably craftsmen. The smallest of the three families, "technical work, engineering and related fields," consists almost entirely of science and engineering technicians, with a few possible exceptions, e.g. "sound-effects man" (194.281).

As for the prefix code numbers, nearly all are beteeen 001 and 019, which contains professional, technical and managerial work in architecture and engineering or from 020 to 029, professional, technical and managerial in mathematics and physical sciences, with a few more in the 040s, life sciences. In addition there may be isolated titles in the 400s (certain agricultural technicians), the 500s (processing occupations), and the 600s (machine trades occupations). In all, there are over 100 defined job titles in the DOT which should be included in the broad category "science and engineering technicians" and another 100 related titles which are not defined.

c) <u>classification of technicians in the Census of Canada</u>: We have seen that neither of the two principal manuals of occupational titles used internationally--the ISCO or DOT--gives a detailed list of the specific job titles which should be included in the general category "science and engineering technician." How then are occupational groups identified in the census? It is not feasible for respondents to be asked to give a lengthy description of their duties and responsibilities to be used by census takers in deciding how to classify them. Nor is it feasible to give respondents a list of 35,000 job titles and definitions from the DOT and ask them to locate the one which best fits them. Instead, the respondent is asked to write down his occupation, and the census must have some guide for grouping these replies into categories. Such a guide is the <u>Canadian Occupational Classification Manual for the 1961 Census</u>, (COCM).

The category "science and engineering technician, n.e.s." appeared for the first time in the 1961 Census along with other new entries such as "computer programmers" in a year which saw the official demise of "harness and saddle makers" and "coopers". In the COCM, in which an individual's occupation is defined "in terms of the kind of work he performs" (p. 7) there are over 170 specific titles listed under "science and engineering technician, n.e.s." This category is included in the major category "professional and

technical" under the sub-category, "other professionals".

Of the 170 specific titles, only 33 contain the word "technician" and two contain the word "technologist". The most common title is "tester", which appears 40 times. The other principle titles are expert, inspector, helper, assistant, and engineer--the last named appears six times. The title "tester" appears in the classification manual 98 times, but the science and engineering technician category is where it appears most. The next most important category for testers is "inspectors, examiners, gaugers, n.e.s." (29 times). The term technician appears in the census manual 67 times; it refers to science and engineering technicians only about half the time. Over one-fourth of the technician entries are under medical and dental, and the remainder are mainly in mechanical and construction occupations. This underlines the point that the appearance of the word technician (or technologist) in the specific job title is neither a necessary or sufficient condition for the specific title to refer to "science and engineering technician, n.e.s."[14]

d) <u>the Canadian Classification and Dictionary of Occupations</u>: To complete the discussion of official classifications of the science and engineering technician, the newest and not yet

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[14]The word engineer appears in the census titles over 300 times, but only about two-thirds of these titles are included under the heading "professional engineer".

completed should be noted. This is the Canadian Classification and Dictionary of Occupations (hereafter CCDO), prepared jointly by the Occupational Research Section of the Program Development Service, Department of Manpower and Immigration, and the Central Classification Staff of the Dominion Bureau of Statistics (DBS, now Statistics Canada).

The CCDO classification is to be based on "the kind of work performed," defined in terms of duties, tasks, and responsibilities. It will be similar to the DOT but will be more relevant to Canada. Unlike the DOT, the CCDO will have science and engineering technicians of all types brought together, but unlike the COCM, the CCDO will separate science technicians from engineering technicians. Technicians will be in Major Group 21--Occupations in Natural Sciences, Engineering and Mathematics:

In Minor Group 211 Occupations in Physical Sciences

Unit Group 2117 Physical Sciences Technologists and Technicians

In Minor Group 213 Occupation in Life Sciences

Unit Group 2135 Life Sciences Technologists and Technicians

In Minor Group 216 Other Occupations in Architecture and Engineering

Unit Group 2165 Engineering Technologists and Technicians

Within the unit groups there will be a further breakdown of occupational titles with 7- or 8-digit code numbers, and detailed definitions. It appears that the CCDO will combine the advantages of the DOT in terms of descriptions of thousands of job titles with the classification and grouping advantages of ISCO. Moreover, the CCDO will go beyond any existing classification scheme by providing a hierarchical ranking of occupations within the unit categories, i.e., between technologist and technician and within the technician group itself.

The Canadian Classification and Dictionary of Occupations (CCDO) will be the only official classification manual to distinguish between levels of work within the engineering technology category. This kind of distinction is of value to educational planning, because the educational requirements for the various levels within the occupational group may be quite different. The basis for this distinction to be adopted by the CCDO appears to be similar to, but not entirely the same as, that published by the Ontario Association for the Certification of Engineering Technicians and Technologists (OACETT).

4. Problems of occupational classification: summary

The classification systems described above attempt to define occupation in terms of the type of work performed without resorting to educational qualifications. Unfortunately, for

the most part, they have not been successful. In the ISCO, the census, and the prefix code of the DOT, the emphasis is far more on the socio-economic status of the job and the training of the job holder than on the nature of the work. The most vehement critic of census occupational classification systems, James Scoville, has argued further that these systems are characterized by vague and inconsistent groupings, poor data, and too great a reliance on "catch-all" categories (1965: 77-79). Scoville has developed an alternative classification system based on job families which has been used by the Dominion Bureau of Statistics and the Ontario Department of Treasury and Economics (1969). While the Scoville definitions are more functionally based than other classification systems, they still leave much to be desired. Scoville accepted the three-digit occupational classes as provided by the census, and recombined them into groups according to nature of work rather than socio-economic status. This is an improvement, but many of the resulting job families are still quite heterogeneous. More seriously, the major difficulties with census data are with the three-digit occupational classes,[15] and changes in the ways of combining these classes do not get to the core of the problem.

In short there is no existing occupational classification system based mainly on work functions, and which would enable

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[15] See Section D below.

us to ask questions about the optimal, or appropriate, education for a given occupation. Most occupational definitions are so ambiguous that a precise enumeration of the stocks of persons in the category is impossible. Skolnik and Bryce have shown that the number of science and engineering technicians in Ontario in 1961 could have been anywhere between about 17,000 and 30,000 (1971: 50-56). A similar range of doubt exists about the number of engineers. This is a serious problem, because a reasonably accurate estimate of current stocks is almost a necessity for projecting the growth of manpower requirements. Occupational definitions are somewhat more reliable for those occupations which have more stringent certification regulations, e.g. medicine. However, for these occupations forecasting is not a serious problem, since any forecast can be self-fulfilling.

We have stressed the need for an occupational classification system based on work functions and skill content of jobs, and we have argued that existing classification schemes are unsatisfactory for manpower forecasting. The question arises as to whether it is possible to develop such a system. Professor Blaug cites a few useful studies, but concludes that much work is needed in the field in job analysis and job specification (1970: 155-56). As yet there has not been sufficient work in this area to justify much optimism, although such work as that of the Ontario Department of Labour (Dempsey, 1970) seems

promising. In conclusion, we must agree with Blaug that "it is high time, therefore, that manpower forecasters abandoned once and for all official statistics on occupations as worse than useless for their purposes" (1970: 159).

D. Data Requirements

The lack of reliable data is at present the greatest obstacle to obtaining reasonably accurate forecasts of manpower requirements. There are a number of serious problems which cannot be overcome by obtaining better data--particularly those associated with the concept of requirements, manpower supply effects and skill substitution, and occupational classification. However, even without tackling these problems, improvement of data could increase substantially our confidence in forecasts.

1. Occupational data

The most serious problem concerns occupational data. The problems of occupational classification and of occupational data are overlapping; but much better results could be obtained even with the present inadequate occupational classification systems if the data were more consistent, reliable, and extensive.

The only comprehensive and periodic source of detailed occupational data in Canada is the decennial census. This is subject to the following problems:

a) <u>limited number of observations</u>: At best, occupational data is available for only the years 1941, 1951, and 1961. It is always difficult to make projections based on two or three points. It is especially difficult during 1971, when the latest information is ten years old.

Occupational trends in highly qualified manpower are subject to substantial changes, and there is some question as to whether the 1941 and 1951 points help in projecting trends between 1971 and 1981 or 1991. For example, the figures for electrical engineers as a percentage of professional and technical employees were 2.13, 2.51, and 1.77 in 1941, 1951, and 1961 respectively. On the basis of this, can one forecast a value of less than 1.77 for 1971? Certainly more information about what has been going on during the middle and late 1960s would be invaluable.

The situation is complicated further by the fact that 1951 and 1961 were very different kinds of years from the point of view of economic activity. Unemployment was at one of its lowest points in the post-war period in 1951, and it hit its highest level in 1961, about 8.4 per cent. Meltz and Penz (1968), in the study discussed above, attempted to correct for this in their projections of employment by industry structure, but they could not make as satisfactory adjustments in their occupational projections.

Another problem with census data is that there have been frequent changes in the occupational definitions, so that the

data from one census year is not directly comparable with that for another year. A considerable amount of tedious work is necessary to make occupational data for different years commensurate, and many occupational classes, especially in highly qualified manpower, cannot be made comparable--which means projecting from a single point.

b) reliability of responses: In the census, individuals are asked to state their occupations. This process is accompanied by an unknown amount of misunderstanding, error, and intentional mis-statement. Only about two-thirds of those who declared themselves engineers in the 1961 Census reported having a university degree, as compared to about 96 per cent in the Department of Manpower's 1967 survey (Atkinson, *et al*, 1970: 47). No definition of "engineer" was provided, so every respondent may have had a different concept of engineer in mind. Without knowing how the respondents interpreted the title "engineer", the meaning of the category is vague. We do not know if all the people included in the category really belonged there under a single consistent definition of the occupation. Watson and Butorac stated that a number of technicians almost certainly declared themselves as engineers, but there is no way of knowing the extent of this overstatement (1968: 91).

c) incompatibility of census data with other data: There are other sources of occupational data, such as occasional

surveys of particular occupational groups and the annual records of professional associations. These sources are not commensurate with census data, and there is no way of relating information from the two sources. The sources use different occupational definitions, and there is no reason to believe even that trends found in one set of data will hold for the other set. The comprehensiveness of the census is a desirable attribute. If it could be regarded as a reliable bench-mark and short-term intercensal variation assayed by means of annual or bi-annual surveys linked to the census base, we could be more sanguine about occupational projections.

d) the occupation-education link: The census is the main source of information on the educational attainment of the population, and more specifically, the educational attainment cross-classified by occupation. The chief problem here is that the breakdown of educational levels is too aggregative and simplistic. In 1961, the census reported only years of elementary and secondary schooling, university attendance, and university degree. Technical and trades schools and all non-university post-secondary education were ignored and it is not at all clear how a graduate of a technical college would (or should) have completed the census question about the level of educational attainment. There was no provision for recording part-time education, formal or informal on-the-

job training, or training while in the armed forces. Neither were post-graduate or professional education classified. Post-secondary education was not disaggregated by discipline. Few of these deficiencies have been remedied in the 1971 census.[15]

Fortunately, much insight into the occupation-education relationship can be obtained from small surveys and micro-studies of firms and industries. If such studies use the same occupational and educational classifications, then the results can be of use in making aggregate level forecasts. Here again, establishing a rigorous, consistent, and widely accepted occupational classification system is the highest priority.

2. Data on national or provincial output

If the occupational co-efficient approach--as opposed to the occupational distribution approach--is to be used, data on output is required. For the goods-producing sectors, e.g., manufacturing, mining, etc., the Census of Manufactures provides a high quality series of annual data at a good level of disaggregation. The only problems are changes in definition

[15] This is not a criticism of the Dominion Bureau of Statistics. While these are deficiencies from the point of view of data requirements for manpower forecasting, they are deficiencies of the census only if it accepts usefulness in manpower forecasting as one of its goals. To our knowledge, this has never been a stated objective of the decennial census. Whether it should be a major objective is a decision to be made not by D.B.S. but by joint involvement of all agencies concerned with manpower forecasting.

over time, and the confidentiality regulation which prevents the publishing of figures for industries in which the number of firms is small.

For the services sectors, such as education and personal services, it has been difficult to develop satisfactory output measures, particularly measures of output which are independent of measures of inputs. For these sectors, the occupational co-efficient approach is not feasible, and employment must be projected by extrapolating the percentage sectoral employment distribution.

3. Attrition and mobility

a) death and retirement: Addition to the stock of a particular type of manpower is required to cover projected growth of the stock and net attrition. Net attrition for any occupational or educational group consists of three types of factors: death and retirement, inter-occupational mobility, and net immigration and inter-regional migration.

There is little comprehensive data available on death and retirement rates by occupational or educational group. While attrition due to death and retirement might seem like a minor factor, even a small error in estimating this rate--e.g. assuming 4 per cent instead of 2 per cent--can have a serious effect on manpower projections when compounded over ten or 20 years. The most common method of calculating occupation-specific attrition due to death and retirement is to assume that age-sex-specific attrition rates are the same for all

occupations and to estimate the rates from data on the age-sex structure of each occupation (e.g. Meltz and Penz, 1968: 40-41). This appears to be a reasonable assumption, at least when comparing the different occupations in highly qualified manpower, and the data on the age-sex structure of occupations is usually available in the census. In working with other than census occupational categories, guess work about the age distribution is sometimes required.

b) <u>inter-occupational mobility</u>: Inter-occupational mobility poses more serious problems. Although over a ten-year period there is likely to be considerable movement between occupations, no evidence is available corresponding to census occupational categories. Thus, it is common in making manpower projections to assume zero net inter-occupational mobility.

Inter-occupational mobility can help to rescue a bad forecast. Suppose that the manpower forecasters have under-estimated the requirements for a particular occupation, and the formal educational system, acting in response to the forecast, has under-produced graduates in this field. Then the requirements may still be met if a sufficient number of people move from other occupations to the one in question. Whether this will in fact happen depends principally upon the transferability of skills between occupations and the extent to which workers respond to labour market conditions by attempting to move between occupations. Of course workers

often attempt to change their occupations for other than economic reasons, but these attempts are constrained by the state of employers' demand for particular skills. The constraints are assymetric. Workers are free to leave occupations which are in strong demand. It is very difficult, however, to go into occupations for which there is weak demand. Thus there is a tendency for the patterns of inter-occupational mobility to be governed by the conditions of demand for labour in the various occupations. For this reason, the lack of data on occupational mobility and assumption of zero net inter-occupational mobility do not lead to serious problems in the manpower forecasting approach to educational planning. If educational planning is based on correct manpower forecasts, there will be little opportunity for inter-occupational mobility. If the forecasts are not correct, whatever inter-occupational mobility is possible will help to bring the labour market closer to equilibrium.

c) immigration and inter-provincial migration: Net immigration and migration, as potential net additions to the manpower stock, are similar to inter-occupational mobility. One important difference is that the federal--but not the provincial--government has some control over immigration. The data on inter-provincial migration by occupational group is not adequate for making projections. There is some data from the census and from surveys of particular occupational

groups (e.g. for scientists and engineers, Atkinson, et al, 1970: 91-101), but data are available only sporadically and according to different occupational definitions. At first glance, the data on immigration by occupation seems in very good shape--there is an annual series going back into the mid 1950s at least (Canada Department of Manpower and Immigration). However, this data is on "intended occupation", and there is little information on whether the individual immigrant possessed reasonable qualifications and no information on whether the realized occupation was the same as the intended one. Even if the intended occupations are generally realized, immigration is difficult to project, since it depends upon fluctuating labour market conditions in both the receiving and donor countries and is subject to government policies. Incorrectly anticipated immigration can have a disastrous effect, turning a potential labour shortage into a surplus. The net growth in requirements for a particular occupation may have been projected with great accuracy, but there may be an unexpectedly large number of immigrants competing with the new graduates for the jobs. For this reason, there should be close co-ordination between educational planning and immigration policy, however difficult this may be. The lack of better data on immigration and emigration is a potentially serious problem. This is more serious than the lack of data on inter-provincial migration, since the latter

can be assumed to be more responsive to short-term fluctuations in the labour market than the former.

d) occupational destination of graduates: When converting occupational projections into projections of requirements for graduates of the educational system, one must forecast the proportion of graduates in a particular discipline who will actually go into the corresponding occupation. Unfortunately, there is almost no data from which this proportion could be estimated. To some extent, this proportion will be a function of the state of the labour market, and the transition from education to various types of occupations can be viewed as a special case of inter-occupational mobility. If manpower forecasters overestimate the proportion of engineering graduates who desire to go into engineering, then too few places may be provided for engineering students. The shortfall in new engineers should improve the market for engineering graduates, and, in turn, the *ex post* proportion of engineering graduates going into engineering may be higher than the *ex ante* proportion. Much research is needed on the relationship between post-secondary education and occupational employment, and attention is called to Professor Harvey's forthcoming work in this area.[17]

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[17] "Education and Employment of Arts and Science Graduates: The Last Decade in Ontario." This study is being prepared for the Commission on Post-secondary Education in Ontario.

Although this part of the project is concerned mainly with manpower requirements rather than the supply, we should close the section on data by noting the inadequacy of data on flows within the post-secondary system. This will be discussed in Part B when presenting the enrolment projections. Estimating attrition of students by discipline is an important part of the manpower forecasting approach to educational planning, and the present data limitations make this task very difficult.

## E. Summary of Major Assumptions Underlying Manpower Forecasting

The path which leads to forecasts of the required occupational or educational distribution of the labour force some years in the future is usually complex, circuitous, and littered with a variety of *caveats* and *ad hoc* manipulations of ratios. By the time one has read through an entire manpower projection study, one may want to reflect on the package of assumptions--most of them seemingly harmless in themselves--which one has bought. Unfortunately, most manpower projection studies fail to make their assumptions clear. A striking exception is the work of Meltz and Penz, which contains a detailed list of all of the assumptions made in the study (1968: 65-66). Most of the assumptions which other studies have used are contained in the Meltz-Penz list.

### 1. Assumptions about smooth trends in output and employment

The assumptions in their list can be divided into four categories. First, there are assumptions which underlie the

linear, or otherwise smooth, extrapolation of past trends in output, employment, and occupational structure. The general assumption is "manpower requirements will change in accordance with past trends" (p. 65). This is a crucial assumption upon which almost all manpower forecasts are based. Implicit is the notion that the future will differ only quantitatively, and not qualitatively, from the past. Obviously the longer the forecasting period, the less justification for this assumption. If planners are attempting to bring about radical economic and social changes, they would be inconsistent to employ a manpower-forecasting methodology based on this assumption. More specific applications of this general assumption are the following two assumptions from the Meltz-Penz list:

a) "changes in the percentage industry structure of employment follow linear trends (except for cyclical fluctuations)" (p. 65);

b) "changes in the percentage occupation structures follow linear trends" (p. 65).

Inspection of the relevant tables and figures presented in the Meltz-Penz report (8-11) suggests that (a) is a plausible assumption. Since we have recommended a methodology based on projecting industry output and productivity rather than the industry structure of employment, the corresponding assumptions for our projections have to do with the trends

in output and productivity. These are assumed to be systematically non-linear, as discussed in Part B, Chapter I. Corresponding to assumption (b) about the percentage occupation structure, we have assumed a specific non-linear function for the trend in occupational co-efficients. Where data was available on the occupational co-efficient only for 1961, we have assumed it constant, a frequent assumption in manpower forecasting studies.[18] Assumption (b) above is a strong and dubious assumption, but ignorance compels it. At a high level of aggregation, the changes in the percentage occupational structure have been fairly smooth, but the percentages are very unstable at finer levels of disaggregation.

An analogous assumption about smooth trends in the education structure of occupations is made in the first of two types of projections of educational requirements made in the Meltz-Penz study. In the second method of projecting educational requirements, it is assumed that there will be a discontinuity between the past and future, as all new entrants are assumed to have the educational qualifications which employers desire in the target year. Here it is assumed that for new entrants into the labour force, "the required set of educational qualifications for each occupation class

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[18] The limitations of the assumption are discussed in the relevant section of Part B, Chapter I.

is unique" (p. 66).

2. Assumptions about aggregation and reclassification of census data

A number of assumptions are required in order to disaggregate the projections for occupational groups into projections for occupational classes. In the Meltz-Penz study, occupational groups (e.g. professional and technical) were broken down into occupational classes (e.g. engineers) only after the projections for the occupational groups had been aggregated over all industries. This procedure involved an assumption that "the distribution of occupation classes in each occupational group among industries is proportionate to the distribution of that occupation group among the industries" (p. 66). Unless this assumption is a good approximation to reality, the projections would be improved by disaggregating the occupation groups into classes before summing over industries, a tedious job. However, given the heterogeneity of occupation groups, the assumption seems likely to be violated. For example, the distribution by industry of "interior decorators and window dressers" is certainly different from the distributions for civil engineers, or medical technicians. All classes are in the professional and technical group. Nevertheless, it should be noted that in the Mediterranean Regional Project, disaggregation by occupational group and industry "did not contribute signifi-

cantly to the occupational distribution" (Hollister, 1967: 72).

Other assumptions were required in order to allocate the "occupation not stated" group among the other occupational groups and to handle the problems of occupational groups which were not comparable between censuses. These assumptions must vary from study to study depending upon the precise limitations of the census data for the place and period in question. They are discussed in more detail in Part B where it is necessary to make assumptions similar to those of Meltz and Penz.

3. Assumptions concerning net attrition

Largely out of ignorance, manpower forecasters are often forced to make strong assumptions about the factors affecting net attrition. These have been discussed in Section D of this chapter, e.g. zero net inter-occupational mobility, and that discussion will not be repeated here.

4. Assumptions about the effects of manpower supply conditions upon the amounts and types of labour demanded

The substitution problem has been described in Chapter III. It arises when the amounts of different types of labour required per unit of output are not fixed rigidly by technology but can be varied in response to the relative supplies of the different types of labour available. Forecasting problems arise because changes over time in the occupational distri-

bution or in occupational co-efficients could be the result of changes in technology or the result of substitution induced by changes in relative supplies (or some combination of the two effects).

Hollister has provided some examples of substitution based on the experience of the Mediterranean Regional Project. He reported that from 1956 to 1960 in Yugoslavia, there was a large increase in the supply of graduates with higher qualifications and that large numbers of workers with higher than average qualifications were absorbed into employment during these four years. The trend in occupational structure from 1956 to 1960 "probably reflected not so much a change in technological conditions of demand as a change in the relative supplies of types of labour" (Hollister, 1967: 33). He noted that if the trend in educational requirements for Yugoslavia were forecast from 1960 data, the educational requirements would be overestimated. This type of bias conceivably could be avoided by using a simultaneous equation model which incorporated a supply function as well as a demand function. In fact, attempts to do this have been almost non-existent (for a step in this direction, see Adelman, 1966). Most manpower forecasting models assume (usually implicitly) that supply effects are non-existent, i.e. that the elasticities of substitution between different occupations are zero.

Substitution can occur at a number of different levels. Hollister is concerned mainly with occupational substitution within a given technology and structure of output, and with educational substitution for a given occupational mix. The essence of occupational substitution is that the number of people in any occupational group that employers will seek to hire is not determined entirely by technology, but is affected also by relative supplies. For example, with a given state of technological knowledge, the number of engineers that will be demanded by the manufacturing sector is a function of the relative numbers available (hence of wages) of engineers, technologists, technicians, etc. Even if occupational substitution is impossible, and the number of engineers per unit of output is fixed by technology, there may be educational substitution, i.e. it may be possible to vary the educational patterns for producing engineers. Meltz and Penz have assumed away these two types of substitution through assumptions (a), (b), and (c) below.

a) "The occupation structures in the past have been determined primarily by the prevailing technology rather than supply conditions" (p. 65);

b) "The heterogeneity of educational qualifications found in each occupation group is primarily a reflection of the heterogeneity of productive functions within the occupation group" (p. 66);

c) "The structure of qualifications and functions are primarily determined by technology rather than by manpower supply conditions" (p. 66).

If the occupational and educational requirements of the labour force are determined mainly by technology and the structure of output, then it is necessary to assume also that the latter two factors are not influenced by labour supply conditions. Most authors have neglected to make these assumptions explicit, but again Meltz and Penz have included in their list the following two assumptions:

d) "The industry structure in the past has been determined primarily by the structure of output and by the prevailing technology rather than by labour supply conditions" (p. 65);

e) "Furthermore, the structure of output and technology are independent of the skill structure of manpower supply" (p. 65).

It is hardly possible even to speculate on the validity of the above assumptions about the effects of manpower supply conditions. The lack of adequate research on substitution has been without doubt the biggest shortcoming of research in manpower economics. There has been very little empirical research in this area, and what has been done has produced inconclusive and often contradictory results.

The main reasons for the limited research progress lie in the various methodological difficulties, which have been summarized by one of the authors elsewhere (Skolnik and McMullen, 1970: 30-33). In that study, the authors estimated substitution between engineers and technologists in Canada by an interview case study method. In an earlier work, the same question had been approached using an econometric method developed from previous work by Professor Grilliches (Skolnik, 1970). The econometric study showed a high degree of substitution. The interview case study approach based on 16 large employers of engineers and technologists showed very limited substitution possibilities. The latter study revealed a number of social and institutional barriers to replacing engineers with technologists. It did not include job analysis, so it did not explore the purely <u>technical</u> feasibility of such substitution.

Skolnik suggested possible reasons for the discrepancy between the results of the two studies. Most importantly, perhaps, the econometric study allowed for longer-run adaptation to supply conditions than the interview study which focussed on short-run behaviour. Secondly, the data for the econometric study were poor, and some spurious correlation was possible. Thirdly, there may be some tendency for interview studies to give results that show less price-elastic behaviour than econometric studies. This seems to have

happened in studies of the effect of interest rates on investment decisions (Meade and Andrews, 1938; Andrews, 1940). The case studies simply cannot be ignored, as some economists would do (Machlup, 1946: 534-35), by saying that business men do not do what they say they do. As Joan Robinson has pointed out, no *ex post* data will reveal what the *ex ante* substitution possibilities were, or if different hiring and staffing decisions would have been taken if relative wages and labour supplies had been different (1970: 315). Finally, even if the results of the Skolnik-McMullen interview study are valid, and substitution between engineers and technologists are or were quite limited in the short-run, there may be much greater substitution possibilities between other occupational and educational categories in the economy.

A few econometric studies in other countries have reported considerable substitutability between different educational groups (e.g. Welch, 1969; Maton, 1969). In addition, a growing body of less formal evidence suggests that substitution possibilities are considerable. Hollister observed that in the Turkish Report of the Mediterranean Regional Project, it was found that the projected requirements for Class C skilled industrial, clerical and sales workers could not be met through any conceivable expansion of the educational system. So it was decided to train the additional workers through

extra vocational programs, "clearly a case of substituting one educational program for another" (Hollister, 1967: 35). Hollister further found such great variation in occupational co-efficients among Mediterranean Regional Project countries as to conclude that "there is no indication that the occupational input per unit of output is technologically fixed" (p. 48). A similar conclusion was reported in the London School of Economics study of manpower utilization in 168 electrical engineering firms in Britain (Layard _et al_, forthcoming). C. A. Anderson, in a very impressionistic piece, has given numerous examples of substitutability (1967).

All of these examples pertain to occupational and educational substitution, and call into question assumptions (a), (b), and (c) above. Assumptions (d) and (e) about the lack of effect of manpower supply conditions upon the structure of output or the choice of technology have not been challenged--although explored very little. Doeringer and Piore (1966) in an excellent micro-study have given a number of convincing reasons why _relative_ manpower supplies do not affect the choice of technology, and L. E. Davis (1955) _et al_ reported that job design was altered only in case of the most extreme changes in labour-market conditions. Meltz and Penz have, however, taken the opposite position, that "certain types of technological changes may be introduced in direct response to labour shortages, or such scarcities may change the structure of

final demand by inducing changes in the price structure of final products" (p. 66).

There is less doubt and conflict with regard to occupational and educational substitution. While the research findings are not systematic, and there are no doubt exceptions, we support Hollister's conclusion that "substitution possibilities both exist and can be important in their effects on manpower requirements estimates" (p. 72). To this it might be added that in the absence of a variety of certification and other institutional barriers, substitution possibilities would be much greater.

## F. Summary

Chapter V contains a survey of the current state of the art of projecting manpower requirements. The chapter begins with a clarification of the concept of manpower requirements. It is noted that some writers assume implicitly that there is only one possible occupational composition for a level and composition of national (or provincial) output. This assumption is described as unwarranted, and the case is made for manpower projections based on assumptions of some flexibility in the relationship between the occupational/educational structure of the labour force and the composition and level of output.

The next part of the chapter is an overview of the most commonly used methodologies for making manpower projections. A recent projection study by Meltz and Penz for the Canada Department of Manpower and Immigration is analyzed as an

example and basic variants of their methodology are discussed. In particular, attention is given to omitting the occupational link, and to using the occupational-co-efficient approach instead of the occupational-distribution method.

One of the most serious sources of difficulty in manpower projection studies is the inadequacy of occupational classification systems. Alternative classification systems are discussed and the deficiencies of each pointed out, taking science and engineering technicians as an example.

However, the most serious problem facing anyone who would try to project manpower requirements is the lack of reliable data. The major gaps and inaccuracies in required data are noted, and the limitations of having to rely mainly on census data are discussed.

Most manpower projection studies have been based on a large number of usually implicit assumptions. The main assumptions are listed and available knowledge relevant to assessing the plausibility of these assumptions is presented. Particular attention is given to assumptions about the substitutability between different types of labour. It is noted that there is growing evidence to support the notion that the potential for substitution between workers with different educational and/or occupational backgrounds is greater than is generally assumed in manpower projection models.

While it is possible to describe most of the major difficulties involved in projecting manpower requirements, it is not possible to specify quantitatively the degree to which these difficulties render the projections inaccurate or the amount by which action to overcome these difficulties would lead to improvement of the projections.

Certainly an increase in the reliability of projections would result from an improvement in the data bases. Even with greatly improved data, however, fundamental conceptual problems would limit the reliability of manpower requirement projections: developing a meaningful occupational classification system, understanding of the factors which determine the changes in sectoral productivity over time, and assessing the extent to which existing patterns of manpower utilization are influenced by available supplies.

# CHAPTER VI

## THE USES OF MANPOWER FORECASTS

Whatever the assumptions and methodologies upon which manpower forecasts are based, there remain alternative approaches to their exploitation for the improvement of manpower policy. When direct intervention in market processes is to be avoided, their use may be limited to providing information to current and prospective students about career opportunities. Certainly this approach is the most appropriate when the inadequacy of information is identified as the principal reason for lack of congruity between student decisions based on their perceptions of future demand and the demand conditions they subsequently face.

When more direct intervention in individual decisions is advocated, manpower forecasts can be used for prescribing the numbers to be admitted to the sub-sectors of post-secondary education. One approach to matching enrolments to these prescriptions is a system of differential financial inducements. Fees may be raised (lowered) and grants decreased (increased) in programs for which projected requirements are low (high). This, however, will be a more-or-less effective system depending upon what is known about the responses of students to variations in educational costs.

If neither the provision of better information nor manipulation of fees help to channel students into courses for which

requirements are growing and away from courses of falling demand, then still more direct controls may be necessary. The state might allow only the number of places in each program that are justified by the forecasts. Presumably, this approach will work more efficiently in one direction than in the other. Certainly it can eliminate excess enrolment, but it is doubtful that people can be required to study in fields for which the manpower forecasts show increased requirements.

A. Providing Information to Students

Providing good information to students is likely to improve the working of the market for highly qualified manpower. However, there is not enough known about the process of student decision-making to predict the extent to which better manpower information will help to ameliorate shortages and surpluses.

This may seem a curious statement in view of the large amount of research that has been done on career choice, correlates of educational attainment, and enrolment forecasting. Unfortunately, this research has not included sustained efforts at determining the effect of (anticipated) labour market conditions upon students' decisions.

1. Lack of research on factors influencing the demand for education

The large amount of sociological and psychological literature on career choice (for surveys see Roe, 1957; Super, 1957;

Beardslee and O'Dowd, 1962; Hilton, 1962; Holland, 1967; Zytowsky, 1968) and educational attainment (for surveys see Summerhill, 1962; Waller, 1964; Sexton, 1965: Marsh, 1966; Spady, 1970) has been concentrated upon the correlates of individual choices and the prediction of those choices. Presumably, information about employment opportunities has been open to all students, and, as such, it has not been singled out as an important explanatory factor.[1]

Recently there has been an increasing number of economic studies of the demand for education, relating enrolment demand to economic variables, particularly fees and income (Duncan, 1965; Campbell and Siegel, 1967; Galper and Dunn, 1969; Crean, 1971; Handa, 1971; Hoenack, 1971). Several of these studies have included indices of current employment conditions as opportunity cost variables, e.g. Duncan's and Crean's (1971) studies of the relationship between unemployment rates and drop-out rates. None has included expected employment and earnings conditions after successful completion of education. Moreover, nearly all of these studies have dealt only with aggregate enrolment and not considered what is essential in the manpower planning context, the demand for places in different programs, or fields of study. The enrolment

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[1]It is likely that quality of information about labour-market opportunities, as well as insights regarding the labour market, are highly correlated with the most powerful explanatory factors--attitudes, education, and socio-economic status of family.

forecasting studies generally have relied upon fairly mechanical projection techniques and have not attempted to explain enrolment trends in terms of socio-economic variables.

The only evidence to support the contention that students' educational plans are responsible to labour-market conditions is based on very simple correlations, or is of an anecdotal nature. Such evidence, even if valid, does not suggest the strength of the responses or the length of time lags between changes in the market demand for certain skills and the corresponding changes in students' enrolment demands.[2]

2. Students' information about labour-market conditions

Regardless of the effect that availability of information might have on students' educational investment decisions, it is still important to assess the information which students have about career prospects in various fields. If it can be shown that students already have the best obtainable information about the state of the market in their fields, there may be little reason to consider systematic methods of dissemination of market research findings. If, on the other

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[2]Some unofficial evidence of this kind was presented at Council of Universities of Ontario Invitational Meeting on Academic Staff Supply and Demand, Toronto, July 27, 1971. Some officials reported large declines in the intake of students in the first years of Ph.D. programs in those fields where manpower forecasts indicated the greatest over-supplies of Ph.Ds. See von Zur-Muehlen, 1971; Ross, 1971; Kelly, 1971.

hand, students do not have effective access to this information, there are potential gains (in terms of a more efficient or responsive market) to a more systematic dissemination of information. Whether there will be actual gains depends upon that poorly understood process, how students make their educational plans.

Unfortunately there has not been a good assessment of the quality of students' information about employment opportunities in Canada. An interesting comprehensive attempt to compare students' beliefs with actual data is the recent work done by Dodge and Swan (1971). On the basis of replies from over 700 students at Queen's University, they concluded that "in general, information about starting salaries for graduates appears to be poor" (p. 30). On the average, students underestimated starting salaries, particularly for pass arts graduates. Students tended to underestimate also the career earnings of pass arts graduates. Male students overestimated the earnings of engineers. And students tended to overestimate lifetime earnings in the career of their first choice relative to other careers. Appropriate to their neoclassical framework (3-8), Dodge and Swan solicited information on students' beliefs only about earnings in various occupations, and not about future demands for their skills. The current interest in their work suggests there will be more research soon on the various aspects of students' economic decisions and their information base.

The sources and quality of students' information about labour-market conditions is the aspect of student decision-making on which it might be easiest to carry out research. Such research should be helpful in deciding on the need for systematic provision of this information to students, and perhaps even on the more efficient methods of dissemination.

3. Responses to manpower projections

If projections are disseminated widely to decision-makers, their behaviour may be altered as a consequence. Indeed, this would seem to be the principal purpose of disseminating manpower forecasts. In that case it may be desirable to accompany the initial forecasts with revised versions taking into account several sets of feasible responses by students and employers to the initial forecasts.

The feedback effects of projections upon decision have been well described and classified by W. Lee Hansen (1965). Hansen distinguishes among five types of manpower projections, which he calls: requirements (R), availables (A), outcomes (R-A), outcomes with responses [(R-A)±B], and actuals [(R-A)±B±C].

Projected requirements refer to the numbers of workers required for a given level and composition of output, derived from forecasts such as those described in Chapter V. They are based upon certain assumptions about "productivity change,

factor substitution and the like" (p. 12).

Availables denotes the projected supply of workers with the necessary skills, given certain assumptions about attrition, migration, occupational mobility, etc. Projections of requirements by themselves are of limited value to student decision-makers, since it is the balance between demand and supply that determines their job opportunities. Projected supplies (availables) are the necessary complement to requirements for even the most basic efforts at career planning. Just as demand projections subsume the anticipated behaviour of employers, so do supply projections subsume the anticipated behaviour of the students' peers.

Projected outcomes describe the *ex ante* balance between requirements and supplies, which might be called *ex ante* projected surpluses or shortages. On the basis of their knowledge of projected outcomes (R-A), employers and students may plan to respond to anticipated shortages and surpluses via changing requirements by an amount $B_R$ and availables by $B_A$. Projected outcomes with these planned responses to projections taken into consideration are defined as $[(R \pm B_R) - (A \pm B_A)]$, or $[(R-A) \pm B]$ where $B = B_R + B_A$. Projected outcomes with responses is also an *ex ante* concept.

Projected actuals include the *ex post* reconciliations ($C_R$ and $C_A$) of the differences between requirements and supplies. These responses would be only short-run adapta-

tions, as compared to the _ex ante_ adaptations $B_A$ and $B_R$. Hansen notes that it is not clear into which category most projections fit, but he believes them to be actuals--which "represent some best estimate of the levels of employment and labour force that will be observed in the projection year, given the assumptions of the projection"[3] (p. 13).

Hansen's typology indicates that some assumptions about responses to projections are implicit in conventional manpower projections. He shows that the past observed values of employment upon which projections are based embody both B and C types of responses. The projections made by extrapolation of these past actual values of employment would appear to be projections of the actuals. However, unless the balance between requirements and availables is about the same during the projection period as it was in the past, the response pattern will be different from that which generated the past values of actuals. A different pattern of responses in the future than in the past would then cause the extrapolations to be in error. This argument is really a restatement in different terminology of our earlier discussion of the errors that are introduced into manpower projections

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[3] One must assume an error in notation, and that actual employment should be $[\min(R, A \pm B \pm C]$ rather than $[(R-A) \pm B \pm C]$.

when supply effects are not taken into consideration. Hansen's typology of projections supports the supposition that these errors will occur unless there are projections of both supplies and requirements, and adjustments to disequilibria are understood and projected. Hansen assumes that responses of both employers and students to apparent imbalance between supply and demand can vary considerably, both in the *ex ante* and *ex post* senses. For if there is no flexibility, then in his notation, B = C = 0, and actual employment is simply the lesser of R and A (see footnote 3). He concedes, however, that adjustments in requirements, $B_R$ and $C_R$, may be less easy than adjustments in availables, $B_A$ and $C_A$, as possibilities of substitution between different types of labour or between man and machine may be less significant than inter-occupational mobility, return of temporarily retired workers to the labour force, retraining, and changing one's course of study.

In addition to using this analysis to emphasize the importance of making supply projections and considering supply effects, Hansen raises several questions about the wisdom of the dissemination of manpower projections (14-16). Dissemination of information is regarded generally as a good thing, and Hansen is perhaps alone in his sceptical reluctance for universal availability. He has given two main reasons, neither entirely convincing.

First, he points out a variety of bizarre reactions that students and employers may take in game theoretic responses to the projections. For example, employers may react to published projections of a shortage of a certain type of manpower by curtailing their training programs "in expectation of a stepped-up government training program" (p. 15). Or, individuals may prepare for the occupations where surplus labour is forecast, on the assumption that other people who were planning to prepare for that occupation will switch to the fields where shortages are projected. "In short, most anything could happen" (p. 16).

Hansen is assuming that people do respond to forecasts, however, and in that case it is difficult to believe that they are not already responding to a variety of impressionistic, anecdotal forecasts of even more dubious validity than the ones which he is reluctant to popularize. Presumably, in the present circumstances, everyone is responding to his own information, and one does not know what information others have. Insofar as it is important for one individual to be able to predict other people's behaviour, the argument for universal dissemination or availability is clear. One might, of course, contend that the greater the ignorance in the world, the more likely are the errors resulting from bad guesses to cancel out. This is, however, a counsel of despair.

Conceivably a population unusually sensitive to manpower-demand forecasts and very uniform in responses might behave in such a way as to make the universal dissemination of those forecasts the cause of unfortunate instability. It would then be difficult to imagine, however, that such a population is not already responding very foolishly to the information they are already receiving. It is hard to believe that increased quantities and quality of information will not produce better decisions in any population than will less, and less perfect, information. Moreover, ignorance is never distributed equally, and unless the best information is public property, public policy must be said to be buttressing the favoured situation of those who now monopolize that information.

In his second point, Hansen does indeed assume a population with sensitivity to manpower forecasts that few of us would expect. He notes that projections are likely to have great errors, and they "will probably induce unnecessarily large over- and under-responses once they are published." Such responses may prove to be considerably less efficient than the inefficient responses the projections are designed to eliminate (p. 16). This will be true only if (i) responses to published projections are stronger than responses to impressionistic judgements about the future, and unpublished rumoured projections; and/or (ii) the accuracy of the

published projections is less than that of the other sources of information. Condition (i) seems plausible if individuals give more weight to information that they consider to be of better quality. It is unlikely that condition (ii) would hold simultaneously with (i), unless individuals were very poor judges of the quality of information. It seems likely that the published projections would be more accurate than the other sources of information and that individuals would react more strongly to the former than to the latter. There is no doubt, however, that error probabilities should be made explicit when the projections are published, and more attention should be given to the differences in the reliability of projections for different occupations, as Ahamad has done (1970).

It is interesting to note that a population which would respond to manpower projections so readily that their publication would constitute a barrier to an efficiently functioning labour market is demonstrating remarkable institutional flexibility. With that degree of flexibility, manpower planning is not likely to be needed. In a world where projections are needed, there is some institutional rigidity, and the kind of responses suggested by Hansen doesn't seem probable.

Hansen's unusual attitude to projections dissemination is interesting, but far more important is his contribution in

emphasizing the need to make projections of supplies as well as of requirements, and in calling attention to the importance of considering responses to projections. Furthermore, it would be difficult not to agree with Hansen, and with Myron L. Joseph (1966: 162), that in the area of manpower research, the highest priority should be the development of a satisfactory framework within which projections now available can be used effectively.

B. Manpower Projections and Differential Fees

A neoclassical economist might argue that the problems of shortage and surplus of highly qualified manpower stem not so much from market failure as from failure to use the market. He might point out that while the demand for education may be influenced by the price (fees less scholarships plus opportunity wage loss), the supply of post-secondary places is not responsive to any price variable, and the price of post-secondary education is not allowed to vary with the supply-demand conditions. A step in the direction of using the market mechanism more--combined with planning--would be to raise fees and reduce financial assistance to students in disciplines for which there is a weak demand in the labour market and reduce fees and increase assistance in disciplines in which there appears to be a strong demand for graduates.

There are three problems that come to mind in connection with the implementation of such a policy. First, there are

no data on price-elasticities of demand for post-secondary education by discipline, faculty, or program. One would have to assume price-elasticity to be the same for all programs in order to exploit the price-elasticity of demand studies that have been done, which estimate price-elasticity of demand from an aggregate enrolment demand function (Campbell and Siegel, 1967; Handa, 1970). This assumption of uniform price-elasticity would be unrealistic. Furthermore, since those studies show demand to be not very elastic with respect to fees, fees would presumably have to be raised or lowered substantially in at least some programs to bring about small changes in enrolments.

The second problem in manipulating fees and direct financial assistance arises from the complexity of the network of financial assistance for post-secondary education. There are many government agencies, public foundations, and private institutions offering financial assistance to students. Many of these grants, subsidized loans, and work fellowships are tied to particular courses of study. These programs of financial assistance for different courses are certainly not systematically determined according to labour-market considerations. Given this array of financial assistance, it is very difficult to specify the net financial incentives for different courses at a given point in time.

The third and by far the most important problem associated

with the implementation of a manpower policy based upon the demand for qualified labour is that it would hopelessly entangle a whole set of policy objectives. Like any policy stratagem, the benefits and costs of this approach include its positive and negative effects on other policy objectives emanating from the same level and department of government and from other levels and departments. Looking only at the cost side of the probable effects of such a fee system on other policy objectives, the following are a small portion of those that are associated with this approach to serving manpower policy objectives.

Changes in post-secondary fees will have a host of immediate effects upon the distribution of income. For those students already in programs where fees fall and for those who come into them later but would have done so even at the earlier, higher rate, the result is an increase in the present value of the expected returns to their educational investment. For their counterparts in programs where fees are raised, the result is decrease. In the case of the former students, this is, in effect, surplus income, or income which could be denied them with no reduction in the quantity or value of labour expected from them. In the case of the latter students, the loss is in effect the taking away of some portion of their surplus income. Presumably they were earlier facing probable return to their educational

investments greater than was necessary to call forth the quantity and value of labour expected from them. This redistribution may or may not be regarded as unfortunate in terms of the distribution policy objectives in that jurisdiction. It is, however, unplanned and likely to frustrate some distribution policy objectives.

There are also many other possible social objectives related to but separable from income distribution likely to be affected by such a fee policy. A jurisdiction attempting to affect the ethnic, geographic or income class mix among the entrants to certain callings may find that a system of differential fees makes any desirable readjustments in this phenomenon out of the question. These sorts of objectives are usually related to very general goals of social stability or non-traumatic social change. For similar reasons a jurisdiction may favour easy access to post-secondary educational programs for its blue-collar workers.

Erich Fromm has pointed out that "if . . . a bored and angry blue-collar worker on a repetitive job develops traits of violence, anger, sadism, slight depression, and indifference . . . he will sometimes be a bad citizen in the sense that he will be easy prey for demagogues who appeal to his resentment and his desire for revenge" (from a 1968 report by U.S. Department of Labor on a conference on Job Satisfaction. Quoted here from Sheppard, 1971: 25). An

expensive system of post-secondary education for such a worker and his offspring that renews his hopes in himself and his community can be a very defensible expenditure and political stratagem, and one that should not be undermined by post-secondary fee policies.

Discriminatory fees can be a source of social disharmony even within vocational groupings. Adiseshiah (1970: 19) has pointed out that though engineers as a group are clearly redundant in India, there is a shortage of them in chemical engineering, fuel technology, and a few other specialties. Here a system of discriminatory fees would require "taxing" civil, mechanical, and electrical engineers to reward chemical and fuel engineers and a few others. The social implications of this may be modest, but employment opportunities would also call for discrimination between two "classes" of engineering students, those in universities and those in polytechnic institutions. The discrimination would favour the more elite, those in universities. The socio-political results of this may or may not be a tolerable cost to incur for a discriminatory fee policy.

The unfortunate case of India can also be used to highlight the possibility that such a fee policy might even be competitive with other manpower policy stratagems. It would reward specialization in engineering education at a time when students of manpower policy are advocating the avoidance of

specialization in view of rapidly changing technologies (Adiseshiah: 21).

The problems of such a fee policy for efficient allocation of resources within educational institutions with more than one program are quite obvious. They will be more or less severe depending upon the degree of dependency of that institution upon student fees and upon the differences in price-elasticity of demand for places in those separate programs.

C. Manpower Projections and Direct Control Mechanisms

Implementing direct control mechanisms is an alternative to relying on market forces, i.e. market forces with or without discriminatory fees. They may be considered as necessary if, given current fees, the numbers of students who seek admission to various post-secondary programs are less than or greater than the numbers calculated as necessary on the basis of manpower forecasts. However, different problems arise, and direct control mechanisms may be more or less effective, depending upon whether the number of students seeking admission is too high or too low.

When the number seeking admission is too large, some system is required for rationing places. Admission standards are the traditional criterion in educational rationing systems, and admission standards are almost universally understood to mean some documented evidence of specified

academic abilities or certain academic experiences. Frequently admission standards are formally or informally complemented by sex, age, class, influence, race, religion, and politics as the criteria of very effective rationing systems. With or without such complements, admission standards rationing systems almost certainly work to maintain existing inequalities of educational opportunity among social classes. To overcome this problem, quotas may be instituted for different regional, ethnic, and socio-economic groups. A very well-established political authority or an unusually harmonious arrangement among the separate groups within a heterogeneous society would, of course, be a requirement for the smooth implementation and maintenance of such a two-tiered rationing system. Certainly most of the social-political problems associated with a differential fee system apply to rationing systems based on direct control mechanisms.

When the excess demand is very great, and the proportions of would-be students frustrated by extremely high admission standards are large, there may be overwhelming political pressures in a society to change the rationing system or popularize post-secondary education. Even before the dangers of such political pressures are recognized, the competition for entry into universities may become so fierce as to make life intolerable for many students and parents. In the very

important and critical case of the universities within the post-secondary system, the situation will be ameliorated to the degree that excess demand for places in some disciplines is offset by an excess supply in other disciplines. A single-minded determination on the part of middle-class youths to get to university, if such can still be assumed, may be a source of flexibility and stability. If, indeed, for many students the objective is to get to university, there may be no great trauma associated with accepting second or third choice in courses. There is some evidence that course choices are of secondary importance (J. A. Davis, 1967).

Having said that academic standards are the traditional criterion of educational rationing systems, it is difficult to offer any near competitors. In some situations, present employment and work experience are sensible criteria. Occasionally the willingness to contract for long periods of service in a particular community or region or to a particular employer is a very appropriate criterion. It is hard to imagine that these criteria will constitute the basis for an acceptable general rationing system for post-secondary education in this province. Almost certainly, any rationing system here will have to be based essentially upon some form of academic competition.

In any case, the important thing about direct control mechanisms is that they are the means of a rationing system.

The important thing about a rationing system is that there be some politically acceptable mechanism to implement it. What the rationing system will do and how it will be done depend on the effect upon political realities of popular values regarding education, opportunity, and equity. The rationing of something so precious as educational opportunity is the real stuff of politics. It is to be expected that alternative approaches to doing it will be associated with the making and breaking of political careers.

There is, of course, the opposite purpose of direct control mechanisms. It is to be expected that in some fields and at some times the number of students enrolling is less than the number required in conformity with manpower forecasts. Such a situation appears to be quite rare in Ontario and most other jurisdictions today. But our present view of things is coloured by certain current and possibly short-lived conditions. In Britain in the late 1960s, the Committee on Manpower Resources for Science and Technology was making the case that there were not as many students electing to study science and technology as there "ought" to have been. Gannicott and Blaug have shown that their conclusions were suspect, however, terming them the results of a "science lobby in action" (1969: 57-58). The Joint Commission on Engineering Manpower in the U.S. was also making the case for inadequate enrolment demands in engineering as

late as 1969. A year later reports of large numbers of unemployed engineers began to appear.

In Canada there has been either more caution or less interest in the enrolment implications of manpower forecasts. This may be due in part to the fact that there have been fewer forecasting studies, and in part due to the fact that immigration is an effective way of dealing with qualified-manpower shortages here. The most recent manpower study by the Science Council of Canada (Kelly, 1971) is of interest for its warning of a surplus of highly educated scientific manpower.

What would be the case for direct control mechanisms, however, if there were widespread concern for perceived inadequate enrolments in many fields? In societies as free as Canada, there does not exist the opposite of rationing systems. We do not have means to compel specific consumption or investment behavior. It must be recognized, therefore, that direct control mechanisms are not the means to a complete system for controlling educational investment behaviour. Presumably they can augment or replace differential fees and stipends in dealing with excess demand by students for places, but they have no promise for dealing with the opposite problem.

## D. Differential Fees, Direct-Control Mechanisms and Formula Financing of Ontario Universities

In this province, universities obtain a substantial portion of operating revenues from students fees,[4] but the largest portion of operating revenues comes from the Department of University Affairs through a formula system for differentially weighting enrolled students in the different programs. These weights are intended to reflect differences in resource requirements among programs.

Quite incorrectly, it has occasionally been suggested that this formula-financing system is the machinery available to us for implementing a system of differential fees or direct controls to improve the balances between qualified manpower supplies and demands. It is time to emphasize, therefore, that formula financing is one thing and policy tools for adjustments in enrolment are something else.

It is true that we might overlook the problems associated with efficient resource allocation at the institutional level associated with changes in the weights for different programs. Whatever the difficulties this causes to those responsible for the financial planning of our universities,

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[4] Formula fees comprised 18 per cent of basic operating income for provincially assisted universities in 1969-70 (Report of the Minister of University Affairs, 1969).

it could well be a price worth paying for the fulfilment of manpower objectives. Unfortunately, however, the link between those weights and enrolment patterns is indirect, so indirect as to preclude use in manpower planning.

Increasing the weight assigned to programs whose graduates will likely face high demand for their service will lead to an increase in enrolments in those programs only if the universities respond to the new situation by deliberately increasing their places in those programs and then successfully attracting qualified students to fill them. It must not be assumed that this will happen, and it must not be assumed that a reduction in certain weights will evoke the opposite behaviour on the part of universities.

A response of universities to weight changes that are counter to those that manpower planners might want from them ought not to be considered as evidence of perversity in the behaviour of university administration and policy-makers. For example, it is quite likely to be an intelligent response to their perceptions of economies or diseconomies of scale facing them under the new situation.

Finally, it should be emphasized that an increase or decrease in weights associated with particular programs ought not to be expected to result in fee changes. If university administrators are free decision-makers, this response to a

change in weights could hardly be more than coincidental.

In summary, our formula financing system is neither a substitute for, nor a painless method of, intervening via direct control mechanisms to affect student investment decisions.

## E. Summary

There are three ways in which manpower projections can be used to influence educational policy. Manpower projections may be used to provide information about career opportunities to students and prospective students. When more direct intervention in the process of student decision-making is advocated, the manpower projections may be used for determining the number of places to provide in each type of post-secondary program. Thirdly manpower projections may be used as a basis for a system of differential fees and scholarships, raising fees in programs for which projected manpower requirements are decreasing and lowering fees in programs for which projected requirements are increasing.

Providing better information to students about future employment opportunities is likely to improve the working of the labour market. However, there is not enough known about the process of student decision-making to predict the extent to which better information on employment prospects will help to ameliorate shortages and surpluses. In addition to providing students with better information about employment prospects, it is important to project the supplies of

as well as the demands for qualified manpower and to consider responses of students to dissemination of projections.

There are serious obstacles to using manpower projections as the basis for more direct intervention in the educational decisions of students. It is noted that there is not sufficient knowledge of students' reactions to changes in the price of education to embark on a system of differential fees. Also, given the complexity of the network of financial assistance to post-secondary education, it is difficult to control the effective prices for specific courses. Moreover, to implement manpower policy through a system of differential fees would entangle a number of different policy objectives, particularly efficiency objectives and equity objectives.

## CHAPTER VII

## SUMMARY AND POLICY IMPLICATIONS

### A. Restatement of the Purpose of this Report

The purpose of this report is to analyze the extent to which it is desirable and feasible to base post-secondary educational planning in part on projections of manpower requirements. In Chapter I a brief explanation for the present interest in manpower planning and manpower forecasting in Ontario was offered. Now, however, as we are about to discuss some of the implications of our findings concerning the relevance of manpower forecasting to educational policy, it is appropriate to look again at the factors which have motivated many people in Ontario to consider seriously the advantages of basing educational policy upon manpower forecasts. This time the emphasis will be more upon the recent history of educational policy and growth in this province.

#### 1. Concern over the growth of the educational system

The period of the 1960s saw rapid expansion of the economy and of the educational system in Ontario. After coming out of the 1960-61 recession, the Ontario economy grew at a rate of 12 per cent during 1963-69, and per-capita income at 10 per cent. Provincial spending on education went from $261,000,000 in 1961-62 to $1,335,000,000 in 1969-70, an

increase of over 400 per cent. While 28 per cent of the provincial budget went to education in 1961-62, the figure for 1969-70 was 42 per cent, and 71 per cent of the marginal dollar of provincial expenditure. In addition to the increase in scale, the system underwent qualitative changes which made it more diverse and complex. Notable among the additions to the educational system during the 1960s were the system of 20 Colleges of Applied Arts and Technology, many new university campuses, and a large number of new graduate programs.

The underlying motives for this rapid growth of the educational system were principally demographic, political, and economic. The great increase in the school-age population resulting from the post-war baby boom meant that a substantial expansion of the system was required merely to maintain a constant attainment of education per capita.[1] However, a constant average level of education is not a feature of Ontario life. Ontario is a society where it is regarded as the norm for a young man to acquire more education than his father. In part, this is a result of a

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[1]Smith and Skolnik (1969: 12) have estimated that about 19 per cent of the increase in Ontario provincial expenditure on elementary schools from 1938 to 1966 may be attributed to the increased population in the relevant age group.

tendency to raise constantly our standards of what constitutes an adequately educated person. Doubtlessly, it is also due to the increasing wealth, complexity of technology, and portion of our lives devoted to leisure and cultivation of the arts. In addition, it is a consequence of the fact that education is perceived as an important source of upward mobility. Families of middle and lower class who can not expect to better their own positions during their working lifetimes can sometimes find solace in the opportunities available to their children through publicly provided education. These factors create considerable political pressure for expansion of educational systems.

As individuals' appreciations of the large economic returns to investment in their own (or their offspring's) education grew, so did the temptation to conclude that larger social investment in education could benefit the economy. Economists were quick to supply the quantitative evidence that education contributed more to economic growth than other factors and that the social rate of return on education was higher than the rate on investment in physical capital. It was even argued that most of the productivity gap between the United States and Canada was due to a corresponding gap in per-capita educational attainment. That the causal relationship between these gaps could have been just the opposite was considered as a logical but unlikely possibility.

On the basis of such evidence and such motives, a sustained, incremental expansion of the educational system was not to be expected. By the end of the 1960s, education had become the largest component of the public sector in the province, and for the nation as a whole the Economic Council of Canada (Seventh Annual Review) had warned that education and its close competitor, health care, "would absorb the entire potential national product before the year 2000," if present rates of increase continue (p. 38).

The beginning of the new decade is characterized by a recession. The coincidence of the present general recession and the end of the boom in education is striking; nevertheless, they are two separate phenomena, and either one could have happened without the other. Doubtlessly, the end of the boom in education is in part a lagged result of falling birth rates, a more immediate result of the behaviour of professors and students as perceived by the public, the effectiveness of undergraduate and graduate schools and teachers' colleges in dealing with the identified bottlenecks of a decade ago, and the recession. The end of the boom might have come a little bit later and less painfully were it not for the recession but, like all speculative bubbles, it had to end.

Had there been no recession marking the end of the decade, perceived declining returns to individuals for investing

their hopes, energies and perhaps money in post-secondary and graduate education might have resulted in as effective cooling-out and cooling-off processes in the industry as we are now witnessing, but over a longer period of time. That individual perception might or might not have been aided by well-publicized research findings, for example, research in the form of follow-up studies of consecutive cohorts. Consequently, there might not have been the bitterness now being expressed by the long and expensively educated in claims that they have been misled, that society or the government or the universities or somebody has broken faith with them.

At this time, many of the assumptions upon which the rapid expansion of the education systems was based are being questioned. Such questions as these are popular: Although post-secondary education may have been the means to upward mobility when relatively few people were going to university, is this necessarily so when large components of the population go? Have not economists been over-zealous in their calculations of the contribution of education to economic growth? We will leave it to someone else to deal with the first of these questions, and deal only briefly with the second.

In retrospect, it appears that the rapid growth of the Ontario educational system during the 1960s made little or no direct contribution to the expansion in our modern industries.

With the exception of certain municipalities in the U.S., notably Houston and Atlanta, Ontario was perhaps the outstanding example in the world of the 1960s that a jurisdiction need not suffer in the expansion of its sophisticated industries for any inadequacies in its educational system's capacity to furnish the qualified labour they required. Intuitively, however, it was recognized and conceded almost universally that the industrial boom in Ontario was dependent in some important way upon a coincidental expansion of the education industry at all levels, but especially at the post-secondary level.

Faith in the importance of a large educational sector to a healthy economy has been only slightly eroded the last few years. What we know about the connection is still dependent more upon intuition than upon empirical demonstration. We are prepared to suggest that generous educational opportunities from kindergartens through universities are more important to industry because highly educated workers cannot be attracted to or held in a jurisdiction unless such opportunities are available to their offspring rather than because the institutions providing those opportunities actually furnish the skilled manpower those industries require.

If we are correct in this, it must then be supposed that the kinds of lags that educational and manpower planning

must cope with are complex indeed. They involve not only the relationships between present supplies of qualified manpower and the demand for them some years ago (and to come), but also the relationships between the demand for qualified manpower now and the supplies of new cohorts of qualified manpower for a generation to come.

It must also be remembered that the expansion of the education industry was itself an important component of the general expansion of the economy. It was one of the great modern industries requiring large numbers of highly trained, highly paid workers. It supplemented the indigenous supply the same way the other industries did. While people from outside Ontario filled many of the new openings in that industry, Ontario youths (including the children of native and imported teachers and professors) prepared themselves to be the teachers and scholars of the future. Their appearance upon the labour market is an awkward fact of life today, but a highly predictable result of the visibility of opportunities in the education industry a few years ago.

The experiences of the 1960s produced, among other things, the current attitude that education, after all, is an industry in many ways like other industries. This attitude subsumes concepts of purchase from and investment in the education industry, and the supposition that this industry can overproduce or underproduce as the others are known

to do. If it weren't for the latter-day prevalence of this attitude, writing in this vein on education for a public commission would be inconceivable.

This propensity to treat education as an industry accounts for the current attempts to measure educational output; to construct more sophisticated accounts of financial, resource and output flows within the educational system; to develop a new cadre of managers for educational institutions and sub-systems; to rationalize and co-ordinate the component parts of the system; and to plan for the optimal rate of expansion of the system.

2. <u>Concern over unemployment of educated manpower</u>

There are no reliable data on the numbers of people with university degrees who are involuntarily unemployed or working in jobs for which their training appears to be irrelevant. Still less is there any way of knowing to what extent the unemployment or underemployment of graduates is a consequence of the recession and would be alleviated if the economy were operating at some "tolerable" approximation of full employment. Conversely, we cannot say to what degree their problems are the result of a structural disfiguration in the supplies of manpower. Nevertheless, there is a widespread impression that unemployment and underemployment of graduates exists, and, what is more important, young people making career decisions today do not regard a

university degree to be a ticket to a well-paying job as did even very recent cohorts (except, perhaps, for degrees in medicine and a few other degrees leading to trades with associations which can enforce a numerus clausus).

This concern has led some to suggest that too many people are being given post-secondary education. Concerning this view, the following points should be recorded:

1) Education is desirable for non-pecuniary reasons, and a wealthy society can justify some spending on education as a consumer good. And it is to be expected, as the population becomes more immune to arguments about the economic benefits of education, that those who wish to see more spending on education will resort to touting its other values.

2) Education may make people more adaptable to changing technology and changing work environment, and thus it may be a valuable asset of a labour force in an ever-changing world. The fact that this argument sounds trite need not detract from its significance. Of course, it has also been suggested from some quarters (e.g. employers, cf. Skolnik and McMullen, 1970) that highly educated workers may be less, rather than more, adaptable than other workers. If this is the case, the reasons may as likely lie in the graduates' perceptions of labour-market opportunities for past years' graduates as in the curriculum (Lewis, 1968: 80).

3) Education is a long-term investment, and decisions about educational investment should not be guided only by immediate circumstances. Most secondary-school leavers who do not go on to university within a few years of matriculation will probably never go. Without significant social and institutional changes, these youths will be lost to the potential pool of highly qualified manpower.

4) In decisions about public expenditure, there is always a problem of over-reaction to a perceived crisis. Given the very rapid growth of the educational system during recent years, the present danger from "over-correction" is great if there is a lack of caution in cutting expenditures or even in restricting rates of increase. It would be most unfortunate to take action which would turn a possible surplus of several categories of highly qualified manpower into a general shortage in five years. The problem is all the more serious because the decisions will have to be taken during a time of economic recession.

3. <u>Disillusion with benefit-cost analysis in education</u>

Throughout most of the 1960s, there was an optimistic belief that benefit-cost analysis could be of great use in rationalizing the educational system. By the end of the decade, this optimism had faded, and it was accepted that this analytical tool could be useful only in making marginal adjustments of the system or in monitoring small

programs.[2] One of the main problems in applying benefit-cost analysis to educational investment decisions has been the inability to measure directly the output of education, even in the crudest way (Burkhead, Holland and Fox, 1967; Western Interstate Commission for Higher Education, 1970). The use of the earnings of graduates as a surrogate for output has come under increasing criticism in recent years. Even if one assumes that the earnings of graduates reflect their value to society, these data tell us the value of only the <u>next</u> graduate. As discussed in Chapter IV, benefit-cost calculations do not give forecasts of the value of expanding the post-secondary system, or even of a non-marginal increase in the numbers of graduates in certain programs. If we want to answer these questions, we are led to manpower forecasting.

There are, no doubt, a number of other factors which have led many people to consider the desirability of a manpower-based educational policy, e.g. the general tendency toward more social and economic planning. However, we feel that the factors discussed above have been the most important.

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[2] There was a surprising degree of consensus on this view among participants at the North American Conference on Benefit-Cost Analysis of Manpower Policies (Somers and Wood, 1969).

## B. The Desirability of a Manpower-Based Educational Policy

In Chapter III, we discussed in some detail the reasons why a manpower-based educational policy might be desirable. Basically, such a policy would be desirable if the present system of relying primarily on the unco-ordinated decisions of students and employers did not result in the achievement of the manpower goals stipulated in Chapter II-B; and there were reasons to believe that an educational policy based on manpower forecasts would come closer to the achievement of those goals. The goals in question have to do with the availability of qualified manpower for realization of social and economic targets and smooth adjustment to changes in technology, the composition of output, and social priorities.

Assessing the desirability of a manpower-based educational policy involved an examination of the workings of the market for highly qualified manpower. The objective was to see whether the market worked adequately and, if not, whether it could be improved sufficiently by minor reforms. Due to a lack of data, it was not possible to evaluate empirically the performance of the manpower market. We deduced a number of conditions which should exist if the market is to perform satisfactorily, and these were listed in Chapter III-C. A considerable amount of empirical research is necessary to determine whether these conditions hold. Research in this

area, particularly on the post-secondary students' motivation and information processing, would be rewarding.

With such limited data, the most we could say in Chapter III was that the manpower market may often be sluggish, and that a number of institutional reforms, e.g. weakening the power of certification bodies, could increase the adaptability of the system. Without being able to measure the severity of unemployment, underemployment, and shortages of highly qualified manpower, however, it is almost impossible to say whether the more pressing needs are institutional reforms which will improve the present system or major changes in the orientation of educational policy. If these changes in orientation involve a reliance upon manpower forecasts, then, even in the absence of adequate information about the efficiency of the present market approach, it is appropriate to consider the reliability of manpower forecasts as a basis for educational policy.

C. <u>The Reliability and Utility of Manpower Forecasts</u>

The reliability of manpower forecasts was considered in Chapter V. Four major problems were emphasized. Foremost is the substitution problem. It is impossible to say to what extent the observed occupational and educational distributions reflect the availability of manpower rather than the technologically determined requirements. If substitution between different types of qualified manpower is possible, then the

notion of manpower requirements becomes fuzzy; and if the substitution possibilities are great, the concept of requirements becomes meaningless. In such a case, manpower projections are not needed and, in fact, they are not even helpful. Although the evidence on this question is far from conclusive, there is good reason to believe that the substitution possibilities in the economy are substantial, and would be much greater in the absence of certification barriers.

Lack of satisfactory occupational data was cited as another serious problem. In part this is a consequence of inadequate systems of occupational classification, and this was singled out as a vital area for further research, particularly through application of the techniques of job analysis. Even with the existing classification system, there is a great need for more frequent reporting of occupational data.

Part B of this report consists of two separate studies relevant to manpower planning and educational policy making. The first (reported in Part B, Chapter I) is an exercise in producing a set of qualified manpower requirements projections through 1990 for Ontario. The second (reported in Part B, Chapter II) is a set of post-secondary educational enrolment projections through 1990. It is not modesty on the part of the authors that motivates the description of those projections

as illustrations of the difficulties associated with manpower forecasts and the relating of those forecasts to educational policy. Rather it is primarily their lack of confidence in the reliability of manpower forecasts under conditions of such uncertainty about substitution possibilities and skepticism regarding the data.

Those manpower forecasts presented in juxtaposition with enrolment projections invite comparisons which one might be tempted to label demand-and-supply comparisons. Indeed, the making of such comparisons would seem to be the main purpose of manpower requirements and enrolment projections. Such comparisons are not forthcoming in this study not only because of lack of faith in the reliability of manpower forecasts, but also because, in most cases, the enrolment projections could not be made with any reasonable accuracy at a level of disaggregation corresponding to particular occupations. Even where disaggregation is not a problem to the enrolment projections, occupational requirements definition is frequently so vague as to make comparisons more misleading than enlightening, e.g., over a third of "engineers", according to the 1961 census, do not possess a university degree in engineering, and engineering is by no means the calling with the least specific educational requirements.

The link between occupation and education remains obscure.

There is no satisfactory way of specifying the appropriate educational background for most occupations, much less project them. Moreover, all indications are that sectoral productivity and occupational co-efficients are inherently unstable and, for practical purposes, unpredictable. Projections of manpower requirements, in turn, can never be better than the projections of these co-efficients.

These factors contributing to the unreliability of manpower forecasts are the more vexing because they have not been quantified. Consequently the utility of manpower forecasts depends upon the answers to these questions: (i) to what extent do these factors impair the accuracy of the projections? (ii) how accurate do projections need to be in order to be of use in guiding educational policy? (iii) what can be done to improve the accuracy of the projections? Currently there are neither the data nor an adequate conceptual framework for answering these questions. Since comprehensive occupational data are given only in the decennial census, examination of projections from 1961 to 1971 awaits publication of the 1971 census. To answer question (ii) requires a much better understanding than we have presently of the working of the market for highly qualified manpower and the relationship between educational policy-making and the behaviour of students. It requires research on the likelihood of the conditions specified in Chapter III, and much more knowledge of the

substitution possibilities in the economy. As for question (iii), some parts of the answer are clear: a better occupational classification system, better occupational data and job analysis, more statistical analysis of time trends in sectoral productivity and occupational co-efficients, and the development of a more sophisticated theoretical framework within which to view manpower projections.

It may be unsatisfying to conclude a discussion of manpower forecasting with so many open-ended questions. However, the state of knowledge of manpower forecasting leaves no alternative. To a large extent, this is a reflection of the small amount of resources which have been devoted to manpower forecasting. It seems likely that there are yet considerable returns to further investment in definition, classification, data gathering, and analysis of the labour-market context of manpower projections. The results of these studies may or may not encourage further projection studies.

For the present, not only are we unable to simultaneously exploit manpower and enrolment forecasts for policy improvement but we are also scarcely able to combine separate efforts at either manpower forecasting or enrolment forecasting.

D. The Exploitation of Manpower Forecasts in Educational Policy

Those persons responsible for post-secondary educational policy in Ontario are in an unenviable situation. There is,

as we have pointed out in Section A above, considerable pressure now for an overhauling of the post-secondary system with significant changes in policy orientation expected. At the same time, as we have argued in Sections B and C, the data and knowledge upon which the development of new policy directions must be based is lacking. To be sure, this base of data and knowledge was even poorer when the great expansion of the educational system was undertaken. Yet few people seemed to mind, because it seemed that the province could not overspend on so meritorious a good as education. In the present period of less generous funding of educational enterprises, however, information to guide allocation decisions is highly regarded and in great demand.

In the absence of the knowledge that enables policy-makers to predict the outcomes of their actions, caution is advisable. No matter how serious the problems of post-secondary education seem today, they can be made worse by a too hasty change in the structure or processes of the system. Yet some changes need to be made. What is called for is a series of planned incremental changes which would allow new information and knowledge and the feed-back from each step to be digested before the next step is taken.

With regard to the implementation of manpower forecasting techniques, this means beginning by taking all of the steps (noted in Section C) to improve the reliability of manpower

forecasting. This can probably be done best by giving one agency major responsibility for co-ordinating efforts of all related parties, and making continually revised annual forecasts of manpower requirements. At some point, a decision must be made that the forecasts are of adequate reliability to justify dissemination. As argued in Chapter V, this dissemination of forecasts is almost certain to do more good than harm. The reactions of students and employers to these forecasts should be studied, although isolating responses to forecasts from other influences on behaviour will be difficult.

The next step would be to use forecasts to spot areas where excessive shortage or surplus of highly qualified manpower are likely to appear. The label "excessive" will not be easy to define, and care should be taken to allow the widest of margins for uncertainty, both in the requirements projections and in the supply projections. It is a possibility, of course, that students may continue following one another like sheep into a particular course when it has become obvious even with crude forecasts that employers are not hiring people with that training. However, a few cases like this do not prove that students are not rational and that the market does not work. It's what happens most of the time that counts. In those cases of perversity and insensitivity, intervention, preferably in the form of direct control mechanisms, might be

considered, while keeping in mind the non-pecuniary benefits of post-secondary education.

At the same time as these steps are being followed, institutional reforms of the educational system and of the labour market of the kind discussed in Chapter IV above may be considered. As these may reduce the need for manpower forecasting, it may seem contradictory to speak of institutional reforms and the improvement of manpower forecasting simultaneously. However, it would be wrong to think of institutional reform and manpower forecasting as mutually exclusive. Whatever institutional reforms are introduced, it is unlikely that good manpower forecasts will not be of considerable use in managing the post-secondary system. Dissemination of manpower forecasts may do as much to improve the efficiency of the market for highly qualified manpower as any institutional reform. This is all the more serious because many graduates feel that they have been given the wrong information when they were making their post-secondary education plans.

Unemployed and underemployed university and college graduates, M.A.s and Ph.D.s, are a very vocal and dangerous group of dissatisfied citizens. And they are quite correct when they claim not to have been given adequate information at frequent intervals of their school careers about what market conditions they might expect upon graduation. As is so often

the case in times of stress, the temptation is to over-correct. In the extreme case, over-correction would take the form of a political commitment to each student that he will be employed at some administratively determined salary in the work for which he is preparing himself. There is no probability of this happening anywhere in Canada. There is, however, some probability that post-secondary educational policies will be based mainly on high-level manpower projections. This, too, would be an over-correction.

It is a woeful fact that high-level manpower studies and their results have been inadequately incorporated into the decision-making of students, university officials, and provincial policy-makers. It must be kept in mind, however, that in economies as free as this one, i.e. with investment, production, and pricing decisions as decentralized as they are in Canada, manpower studies, manpower projections particularly, can only be expected to guide educational policy adjustments. They can also, of course, be extremely valuable in connection with selected fields of education such as medicine where skill-substitution co-efficients can be expected to be more-or-less fixed for considerable periods of time and total output or service levels politically determined. They cannot logically constitute the bases for general educational policies.

Because research results have a cumulative effect upon common-knowledge and public policy, it must be an objective of educational planning that high-level manpower studies

and projections not be produced in quantities out of proportion to their immediate utility. The alternative may well be an unintended effect upon policy-making. Just as the numerous studies in the early and mid sixties on educational investment and rates-of-returns resulted in what now seem to have been incorrect policies of very rapid expansion, so might a flood of high-level manpower studies result in policy over-reaction. A modest number of well-conceived manpower studies carefully aimed at selected policy decisions may have high pay-offs in terms of adjusting the differential expansion (or contraction) rates of faculties, departments and institutions, and in identifying bottlenecks in our educational production system, the removal of which will offer very high returns on investment.

A too-enthusiastic undertaking of manpower studies, particularly if undertaken by researchers in a mood born of recession and redundancy, may well result in the influencing of policy in the direction of restricting university level education opportunities to the coming waves of massive cohorts produced in the high-fertility years before 1961. It may take only a period of modest economic expansion to discredit such policy very early. It is at least conceivable, however, that such policy can result in seriously handicapping a long series of already disadvantaged cohorts. They face the inexorable stiff competition for places in society that is the lot

of cohorts larger than those before them and after them. To add to this a reduction in the opportunities for university education may well create future generation gaps that will make what we speak of now by that term seem like year-round Father's Day.

# PART B

## PROJECTIONS OF ENROLMENT AND OF HIGHLY QUALIFIED MANPOWER REQUIREMENTS FOR ONTARIO TO 1990

# CHAPTER 1

## PROJECTION OF HIGHLY QUALIFIED MANPOWER REQUIREMENTS

### A. Introduction

#### 1. Objectives

The objectives of this chapter are threefold: i) to present selected data on highly qualified manpower in Ontario; ii) to illustrate by detailed example the methodology for making projections, pointing out along the way the difficulties posed by inadequate data and lack of knowledge about the possibilities for substitution among types of highly qualified manpower; iii) to provide projections of highly qualified manpower requirements for Ontario to 1990 under a variety of assumptions about the rate of growth of output, trends in occupational co-efficients, and other economic factors which affect manpower requirements.

The analysis presented in Section B is based mainly on published and unpublished data from the Department of Manpower and Immigration 1967 Survey of Highly Qualified Manpower and on immigration figures compiled by the Canada Department of Manpower and Immigration and the U. S. Department of Justice. The methodology used in making the manpower projections is described in Section C, where the underlying assumptions are stated and the data adjustments are described. The results of the projections are presented in Section D. Projections

of manpower requirements are presented under a number of different assumptions, and some comments will be made about the sensitivity of requirements projections.

## 2. Definitions

Two types of definitions are important for this study, the definitions of highly qualified manpower and of the industrial sectors for which projections are made.

a. highly qualified manpower: The main purpose of manpower forecasting is to insure that there are neither manpower shortages which could impede the functioning of the economy nor surpluses of expensively trained manpower. As such, manpower forecasting has been concerned mainly with those types of manpower which require relatively long and costly education and training. While some projection studies have been addressed to the entire spectrum of occupations (Ahamad, 1970), most studies have concentrated on the requirements for occupations needing more highly educated and trained manpower.

Studies which deal with only the more highly educated and trained segment of the labour force characteristically begin with a definition of the sector of the labour force for which they are making projections, and with a discussion of reasons for selecting that segment. Most of these definitions of "highly qualified manpower" or "high level manpower" are quite similar, and there does not appear to be anything to be gained from a comparison of the various definitions which have been coined around the world.

We have adopted the operational definition of highly qualified manpower put forward by the Canada Department of Manpower and Immigration (Atkinson, et al, 1970: 13-14). First they suggest four main groups within the Canadian economy which could be identified as highly qualified manpower "depending upon the criteria specified." This list of four groups is quoted below (pp. 13-14):

(1) Those who possess a university degree or its equivalent can be said to be "highly qualified" in a formal sense. One advantage of this definition is that it is possible to locate and describe this type of manpower. According to the 1961 Census of Canada, there were 280,000 university graduates in the Canadian labour force in 1961. This is equivalent to 4.3% of the entire labour force.

(2) The professional and technical occupational group as given in the census can also be regarded as highly qualified. In 1961, 629,000 people were in the professional and technical group. This corresponds to 10% of the labour force. While only one-third of those included in these occupations were also university graduates, a further 15% had undertaken some university education.

(3) There are many high-level occupations outside the professional and technical class which are of equal economic and social importance. The largest concentration of this

high-level manpower is in the managerial category. Managers who are in small business enterprises (e.g. managers of tobacco shops, corner stores, etc.) should probably be excluded since it is inappropriate to group them with managers of large industrial corporations and commercial enterprises. Unfortunately, there is no body of data which allows one to separate out managers by the size of the establishment in which they are employed; however, census "class of worker" data can be taken as a rough guide to size of establishment. Those who are "self-employed" are generally owners of small businesses while those who are "employed" might be assumed to be managers of larger-scale establishments. Under this definition, 278,000 out of the 538,000 "managers" in 1961 might be classed as managers of larger-scale enterprises and might also be said to form part of the resources of highly qualified manpower. This group, together with the professional and technical occupations, accounts for about 15% of the labour force.

(4) The widest possible definition of highly qualified manpower would include all those in the labour force who have some type of education or training which would qualify them for a specific occupation. Unfortunately, information on those who would fall under this definition is very poor. An attempt was made by the Dominion

> Bureau of Statistics in 1966 to survey all those who had received vocational and technical training in the labour force. The survey showed that nearly one-quarter (23.6%) of the Canadian labour force had taken at least one course of technical and vocational training in addition to general education. University degrees were not considered to be vocationally oriented although some (e.g. dentistry, medicine) clearly are. If they were included, the percentage of "qualified manpower" would rise to about 30% of the labour force. It is not possible to say, however, on the basis of this survey, how many of those who received specific training were actually engaged within the occupation for which that training was relevant.

Following this categorization, the authors of that report presented a list of occupational classes for which "sound information was available." This list could be taken as their operational definition of highly qualified manpower. It includes occupations from the professional and technical category for which a university degree is usually necessary. It is presented in Table I-1, and serves as the basis of the definition of highly qualified manpower used in this report.

One exception should be noted. We have omitted "Professors and College Principals" from our definition of highly qualified manpower. It did not appear reasonable to relate the require-

TABLE I-1

Occupational Categories Included in

Highly Qualified Manpower

Civil Engineers
Mechanical Engineers
Industrial Engineers
Electrical Engineers
Mining Engineers
Chemical Engineers

Chemists
Geologists
Physicists

Bio. Scientists
Veterinarians
Physicians and Surgeons

Professors and College Principals
Architects
Actuaries and Statisticians
Economists
Computer Programmers
Social Welfare Workers

Source: Atkinson, A. G., Barnes, K. J., and Richardson, Ellen, _Canada's Highly Qualified Manpower Resources_, p. 20.

ments for this group to the growth of the economy, as was done for other groups such as engineers. Requirements for professors and college principals could have been projected only outside of the general sectoral manpower model described in Section C below. Requirements projections for this group should be based on projections of enrolment and teacher-student ratios. Recently some excellent projection models of this type have appeared, notably von zur-Muehlen's (1971) for Canada, and De Silva's (Council of Universities of Ontario, 1971) for Ontario. With the availability of these studies, it was decided to concentrate our efforts on the other categories of highly qualified manpower.

The definition of highly qualified manpower which we are using ignores occupations for which the typical training is in the non-university sector of post-secondary education, e.g. in the Colleges of Applied Arts and Technology. This gives an unfortunate bias to the definition of highly qualified manpower. Nevertheless, the data for other occupations was inadequate for making manpower projections. The limitations of the data on science and engineering technicians and technologists have been discussed in great detail by Skolnik and Bryce (1971: 49-63). The data for other groups in the non-university sector are not even as good as for this group.

b. sectors and sub-sectors: For the purposes of the manpower projections all the activities of the economy, except defense and "industries unspecified", were classified into two main sectors, the "goods-producing sector", and the "other sector". The goods-producing sector was sub-divided into 37 sub-sectors. A list of these sub-sectors is given in Table I-2. The industries included in each sub-sector and their corresponding industry code numbers from the Standard Industrial Classification Manual used for the 1951 and 1961 censuses are shown opposite the sub-sector. The "other sector" consisted of six sub-sectors, shown also in Table 2 as sub-sectors 38 to 43. Utilities, which by definition belong to the goods-producing sector, were classified in the "other sector" because of the non-comparability between the 1951 and 1961 data.

B. Selected Data on Qualified Manpower

1. Highly qualified manpower in Ontario, 1967

The source of data for this section is the Department of Manpower and Immigration's 1967 Survey of Highly Qualified Manpower, as reported in Atkinson et al (1970) and from unpublished material made available by the Department.

That part of the labour force referred to as highly qualified manpower is overwhelmingly male. Females comprise only 3% of the total. Just under two-thirds of highly qualified manpower employed in 1967 were in the 30-49 age group. Not

TABLE I-2

Grouping of Industries by Sub-Sectors and Sectors

| Sub-Sector | Industry (1961 Classification) | SIC[a] 1961 | SIC 1951 |
|---|---|---|---|
| | Goods-producing Sector | | |
| 1. | Meat Products Industries | 101, 103 | 200 |
| 2. | Dairy Products | 105 | 201, 203, 209, 733 |
| 3. | Fruit & Vegetable Canners and Preservers | 111, 112 | 210, 212 |
| 4. | Grain Mills | 123, 124, 125 | 213, 214, 215, 216 |
| 5. | Bakery Products | 128, 129 | 218, 219 |
| 6. | Soft Drinks | 141 | 220 |
| 7. | Distilleries, Breweries, and Wineries | 143, 145, 147 | 221, 222, 224 |
| 8. | Other Food Processors (and Beverages) | 131, 133, 135, 139, 107 | 207, 225, 227, 228, 387 |
| 9. | Tobacco Products | 151, 153 | 230 |
| 10. | Rubber Industries | (161-169) | (236-239) |
| 11. | Leather Industries | (172-179) | (241-249) + Lasts, Trees & Shoe Findings (89 M. - 44 F.) -243 -Harness & Saddling Repair Shops (part of 249) |

[a]Standard Industrial Classification Manual, Dominion Bureau of Statistics

TABLE I-2 (Continued)

| Sub-Sector | Industry (1961 Classification) | SIC 1961 | SIC 1951 |
|---|---|---|---|
| 12. | Textile Industries | (189-229) | (251-269) |
| 13. | Knitting Mills | (231-239) | 274, 275 |
| 14. | Clothing Industries | (242-249)<br>+395 | (270-279)<br>-274<br>-275<br>-Dressmaking (part of 271) |
| 15. | Wood Industries | (251-259) | (281-289)<br>-286<br>Lasts, Trees & Shoe Findings |
| 16. | Furniture and Fixtures | (261-268) | 286<br>+ Lamps, Electric and Lamp Shades |
| 17. | Pulp and Paper | 271 | 294 |
| 18. | Paper and Allied Industries except Pulp and Paper | 272, 273, 274 | 292, 296, 299 |
| 19. | Printing and Publishing | (286-289) | (301-309) |
| 20. | Iron and Steel Mills, Steel & Pipe Mills, and Iron Foundries | 291, 292, 294 | 320, 325 |
| 21. | Smelting and Refining | 295 | 345 |
| 22. | Primary Metal Industries (Part)<br>Metal Fabricating Industries (except Machinery Transportation Equipment Industries)<br>Machinery Industries (except Electrical Machinery)<br>Electrical Products Industries | 296, 297, 298<br>(301-309)<br>311-318<br>331-339 | (314-329)<br>(341-349)<br>(351-359)<br>-320, -325,<br>-345, -343,<br>-346<br>-Part of 317<br>-Part of 322<br>-Part of 352<br>-Part of 353<br>-Part of 357 |

TABLE I-2 (Continued)

| Sub-Sector | Industry (1961 Classification) | SIC 1961 | SIC 1951 |
|---|---|---|---|
| 23. | Aircraft and Parts MFG | 321 | 330 |
| 24. | Motor Vehicle, Truck Body and Trailer and Motor Vehicle Parts and Accessories Manufacturers | 323, 324, 325 | 334, 335 |
| 25. | Shipbuilding and Repair | 327 | 337 |
| 26. | Miscellaneous Vehicle MFG | 326, 328, 329 | 333, 336, 339 |
| 27. | Non-Metallic Mineral Products | (341-359) | (361-369) |
| 28. | Petroleum and Coal Products | (365-369) | (373-379) |
| 29. | Mfg. of Pharmaceutical and Medicines | 374 | 383 |
| 30. | Paint and Varnish MFG | 375 | 384 |
| 31. | All Other Chemical and Chemical Product Industries | (371-373) (376-379) | (380-382), 38 386, 388, 389 |
| 32. | Miscellaneous MFG Industries<br>-395 Fur Dressing and Dying | (381-399)<br>-395 | (391-399) +300, 332, and 343 +Part of 903 +Part of 332 -Lamp, Electric and Lamp Shades |
| 33. | Agriculture (excludes experimental farms) | (00-19), 021 | (001-079)<br>-077 +Veterinary Services |

TABLE I-2 (Continued)

| Sub-Sector | Industry (1961 Classification) | SIC 1961 | SIC 1951 |
|---|---|---|---|
| 34. | Foresty | (031-039) | (080-089) |
| 35. | Fishing and Trapping | (041-047) | (091-097) |
| 36. | Mines, Quarries and Oil Wells | (051-099) | (100-179) |
| 37. | Construction | (404-421) | (400-439) |
| | Other Sector | | |
| 38. | Transportation, Communications and Other Utilities | 501-579 | 500-549, 600-609, +914 and Part of 406 -Parts of 512 and 608 -Lighthouse Service -Hydrographic Survey Service |
| 39. | Trade | (602-699) | (701-799) +331 and 346 +Parts of 332, 353 and 357 -733 and 739 -Part of 796 |
| 40. | Finance, Insurance and Real Estate | 702-737 | 802-809 |
| 41. | Services; Non-Commercial | (801-828), 831 -807 | 901, 903, 904, 906 +Part of 796 -Veterinary Services -Dental Services |

TABLE I-2 (Continued)

| Sub-Sector | Industry (1961 Classification) | SIC 1961 | SIC 1951 |
| --- | --- | --- | --- |
| 42. | Services; Commercial | 851-899 +807 | 909, (922-924), (932-939), (941-949), 243, 312, 739 +Parts of 249, 271, 317, 322, 352 and 512 |
| 43. | Public Administration (excluding defence) | 909, 931, 951, 991 | (916-919) +Parts of 406 and 608 +Experimental Farms +Lighthouse Service +Hydrographic Survey Service |

surprisingly, this age distribution is not the same for the male and female labour forces. The age distributions for males and females show that the proportion of females under 30 and over 49 exceeds the corresponding proportions for males (Table I-3).

As far as educational attainment is concerned, 5.5% have a pass Bachelor's degree or first professional degree; 19.4% have Master's degrees; 8.2% have their doctorate; 4.5% have professional certification; and 0.5% are unknown.

The reliance on immigration for highly qualified manpower is shown in Table I-4. About one-quarter of the total has come from abroad, mainly from Europe. Nearly half of Canada's highly qualified manpower were born in Ontario. Table I-5 shows that about 45% of Canada's stock of highly qualified manpower is employed in Ontario. This would imply that Ontario is a net exporter of highly qualified manpower. The figures in Table I-5 cover quite a range. Ontario has 93% of Canada's nuclear engineers, but only 24% of its petroleum engineers.

Table I-6 shows the distribution of Ontario's highly qualified manpower by metropolitan area. Because of the small numbers in most metropolitan areas, the table is unreliable for percentages; however, the ordering is probably accurate. It is seen that Toronto is the major location of Ontario's highly qualified manpower, but Ottawa looms large in a number

TABLE I-3

Distribution of Highly Qualified Labour Force by Age in 1967

(all figures are percentages)

| Highly Qualified Labour Force | Less than 20 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | More than 65 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Employed Highly Qualified Manpower (0.3% unstated age) | 0.0 | 2.6 | 13.4 | 13.9 | 15.7 | 18.2 | 15.5 | 8.8 | 6.4 | 3.6 | 1.6 |
| Unemployed* Highly Qualified Manpower (0.2% unstated age) | 0.0 | 27.3 | 39.0 | 7.6 | 3.9 | 3.0 | 2.5 | 1.5 | 2.0 | 3.4 | 9.6 |
| Employed & Unemployed Highly Qualified Manpower (0.3% unstated age) | 0.0 | 4.2 | 15.0 | 13.3 | 15.0 | 17.1 | 14.7 | 8.4 | 6.2 | 3.6 | 2.2 |
| Females Employed & Unemployed Highly Qualified Manpower (0.5% unstated age) | 0.0 | 12.5 | 17.8 | 9.7 | 13.4 | 10.9 | 9.6 | 11.4 | 7.3 | 4.4 | 2.5 |
| Males Employed & Unemployed Highly Qualified Manpower (0.3% unstated age) | 0.0 | 3.9 | 14.8 | 13.4 | 15.0 | 17.4 | 14.9 | 8.3 | 6.2 | 3.6 | 2.2 |

*housewives, students, retired, etc.

Source: Atkinson, et al, 1970. This is the source of all tables in this section unless otherwise noted.

TABLE I-4

Estimate of Highly Qualified Manpower Residing in Canada
By Birthplace & Sex (numbers are percentages)

| Location of Birth | Males | Females | Not Stated | Total |
|---|---|---|---|---|
| North America | 79.1 | 83.6 | 56.4 | 79.3 |
| Canada--Total | 76.6 | 80.5 | 47.7 | 76.7 |
| Nfld. | 0.4 | 0.5 | - | 0.4 |
| P.E.I. | 0.6 | 1.4 | - | 0.6 |
| N.S. | 2.5 | 1.8 | - | 2.5 |
| N.B. | 2.1 | 2.2 | 4.3 | 2.1 |
| Quebec | 4.9 | 8.9 | 4.3 | 5.1 |
| Ontario | 49.4 | 50.1 | 26.1 | 49.4 |
| Manitoba | 4.9 | 4.0 | - | 4.9 |
| Saskatchewan | 5.0 | 5.7 | 13.0 | 5.0 |
| Alberta | 3.4 | 2.4 | - | 3.3 |
| B.C. | 3.2 | 3.4 | - | 3.2 |
| Yukon & N.W.T. | 0.0 | 0.0 | - | 0.0 |
| Canada Unspecified | 0.2 | 0.1 | - | 0.2 |
| United States | 2.4 | 3.0 | 8.7 | 2.5 |
| North America, Other | 0.1 | 0.1 | - | 0.1 |
| Caribbean | 0.2 | 0.1 | - | 0.2 |
| Central America | 0.0 | 0.0 | - | 0.0 |
| South America | 0.1 | 0.1 | - | 0.1 |
| Europe--Total | 16.5 | 12.6 | 13.0 | 16.4 |
| United Kingdom | 8.4 | 5.4 | 8.7 | 8.3 |
| France | 0.1 | 0.0 | 0.0 | 0.1 |
| Germany (Republic of West) | 0.8 | 0.8 | 4.3 | 0.8 |
| Irish (Republic) | 0.1 | 0.1 | - | 0.1 |
| Italy | 0.5 | 0.0 | - | 0.4 |
| Netherlands | 0.8 | 0.7 | - | 0.8 |
| Norway | 0.1 | 0.0 | - | 0.1 |
| Poland | 1.4 | 0.9 | - | 1.4 |
| Sweden | 0.1 | 0.1 | - | 0.1 |
| U.S.S.R. | 1.9 | 1.5 | - | 1.9 |
| Europe, Other | 2.3 | 3.1 | - | 2.4 |
| Oceana--Total | 0.5 | 0.3 | - | 0.5 |
| Australia | 0.4 | 0.2 | - | 0.4 |
| Oceana, Other | 0.1 | 0.1 | - | 0.1 |
| Asia--Total | 1.7 | 1.7 | 4.3 | 1.7 |
| Hong Kong | 0.3 | 0.1 | - | 0.3 |
| India | 0.6 | 0.7 | 4.3 | 0.6 |
| Asia, Other | 0.8 | 0.9 | - | 0.8 |
| Africa--Total | 0.3 | 0.4 | - | 0.3 |
| Other, Unspecified | 1.3 | 0.9 | - | 1.2 |
| Not Stated | 0.3 | 0.3 | 26.1 | 0.3 |

TABLE I-5

Distribution of Ontario's Highly Qualified Manpower by Major Field of Employment with Reference to Canada as a Whole

| Major Field of Employment | % of Canadian HQM in Specified Field Employed in Ontario | % of Total Ontario HQM |
|---|---|---|
| Architecture | 44.70 | 3.14* |
| Engineering--Total | 44.97 | 47.92* |
| Aeronautical | 55.46 | .63 |
| Ceramic | 77.50 | .30 |
| Chemical | 45.05 | 2.22 |
| Civil | 39.00 | 6.75 |
| Electrical--Total | 49.36 | 9.94 |
| Electronics | 50.03 | 5.34 |
| Power | 48.60 | 4.60 |
| Geological | 25.44 | .33 |
| Industrial | 43.95 | 6.54 |
| Marine | 38.89 | .27 |
| Materials | 45.79 | .87 |
| Mechanical | 50.56 | 4.28 |
| Metallurgical | 53.14 | 1.65 |
| Mining | 43.13 | 1.70 |
| Nuclear | 93.17 | .48 |
| Petroleum | 24.20 | 1.21 |
| Surveying | 37.06 | .40 |
| Textile | 70.99 | .37 |
| Transportation | 26.79 | .43 |
| Engineering N.E.S. | 48.59 | 9.55 |
| Physical Science--Total | 48.62 | 14.31* |
| Chemistry | 52.44 | 7.41 |
| Atm., Hydro., Litho. | 34.85 | 2.69 |
| Mathematics | 50.67 | 1.69 |
| Physics | 57.57 | 2.52 |
| Physical Science,NES | - | - |
| Life Science--Total | 34.59 | 8.58* |
| Agriculture | 27.89 | 2.36 |
| Biology | 41.45 | 2.51 |
| Forestry | 30.85 | 1.98 |
| Veterinary | 44.28 | 1.62 |
| Life Science, N.E.S. | 53.23 | .11 |
| Social Science--Total | 50.08 | 9.84 |
| Economics & Statistics | 53.16 | 6.70 |
| Psychology | 56.01 | .79 |
| Sociology | 52.17 | .34 |
| Social Work | 39.60 | 1.69 |
| Social Science, N.E.S. | 44.59 | .32 |

*likely to be unreliable according to survey

continued on next page

TABLE I-5 (Continued)

| Major Field of Employment | % of Canadian HQM in Specified Field Employed in Ontario | % of Total Ontario HQM |
|---|---|---|
| Other Fields--Total | 53.03 | 10.23 |
| Not Stated | 42.95 | 5.98 |
| Total | 45.25 | 100.00 |

TABLE I-6

Distribution of Ontario's Highly Qualified Manpower

By Field of Principal Employment & Metropolitan Area of Employment

| Metropolitan Area | Architecture | Engineering | Phys. Sci. | Life Sci. | Soc. Sci. | Other Fields | Not Stated |
|---|---|---|---|---|---|---|---|
| Brantford | .51* | .34* | 1.49* | .48* | .23* | .62* | .32* |
| Fort William | .71* | 1.05 | .56* | 1.82* | .42* | 1.49* | .69* |
| Guelph | .51* | .91* | 1.32* | 6.10 | 2.50* | 1.47* | 1.01* |
| Hamilton | 2.44* | 6.13 | 4.95 | 2.08* | 3.57 | 6.49 | 3.73* |
| Kingston | 1.32* | 1.67 | 2.56 | 1.08* | 1.52* | 2.93* | 1.44* |
| Kitchener | 1.63* | 1.55 | 2.63 | 1.23* | 1.72* | 2.53* | 2.67* |
| London | 11.09 | 2.30 | 3.37 | 2.94* | 3.73 | 2.90* | 2.24* |
| Niagara Falls | .41* | 1.21 | .42* | .26* | .13* | .34* | 2.83* |
| Oshawa | .10* | .55* | .22* | .30* | .32* | .53* | .43* |
| Ottawa | 9.66* | 12.84 | 21.29 | 20.63 | 25.17 | 15.50 | 12.64 |
| Peterborough | .10* | 2.28 | .80* | .67* | .78* | 5.50* | 1.07* |
| St. Catharines | 1.01* | 2.08 | .67* | 2.60* | 2.21* | .97* | 3.79* |
| Sarnia | .31* | 2.72 | 4.73 | 2.08* | 1.07* | .81* | 1.60* |
| Sault Ste. Marie | .41* | 1.01 | .69* | 1.86* | .36* | .65* | .80* |
| Sudbury | 1.73* | 1.74 | .74* | .63* | .32* | .56* | .96* |
| Timmins | .20* | .23* | .36* | .11* | .13* | .00* | .16* |
| Toronto | 58.09 | 37.54 | 34.71 | 15.76 | 33.70 | 34.95 | 34.93 |
| Windsor | .92* | 1.56 | .94* | .78* | 1.46* | 2.59* | 1.76* |
| Other | 7.22* | 22.29 | 18.41 | 38.36 | 19.82 | 23.85 | 20.53 |
| Total** | 98.37 | 100.00 | 100.86 | 99.77 | 99.16 | 99.68 | 97.60 |

*are likely to be unreliable according to survey
**do not necessarily add to 100.0 due to data errors and rounding errors

Reference: Employment & Earnings by Geographic Area, Department of Manpower and Immigration, 1969, Table 2.

of areas, notably life sciences, social sciences, and physical sciences. The high proportion of architects in London is worth note.

At least one other comment is appropriate to make here regarding the distribution and migration of highly qualified manpower in Canada. Whether trained in Canada or abroad, they display, collectively, a considerable degree of international mobility. Some indication of this is seen in Table I-7, which shows the high but apparently declining ratio of professional emigration (to the U.S.) to university graduations and professional immigration for 1954-1967.

Table I-8 gives labour force status by field of study at the highest degree. Most of the highly qualified manpower group are employees, but there are some notable exceptions--architects, veterinarians, and of course physicians (not included in the survey).

The last trait to be looked at is median earnings by occupation and sex. This is shown in Table I-9, which gives also the number of responses upon which the results are based. The highest median earnings are in social science for men and engineering for women.

The median earnings for highly qualified females are much less (i.e. about $2,000 to $4,000 or between 18 per cent and 26 per cent) than the males' median earnings.

2. Immigration of highly qualified manpower to Ontario

During the period 1959-1970, Ontario absorbed 862,527 immigrants of whom 437,768 (or 50.75 per cent) intended to join the

TABLE I-7

Graduations from Canadian Universities Professional Immigration, and Professional Emigration to the United States, 1954-67[a]

| Year | Total Graduations | Professional Immigration | Professional Emigration to the U. S. |
|---|---|---|---|
| 1954 | 13,793 | 8,350 | 3,352 |
| 1955 | 14,599 | 7,159 | 4,166 |
| 1956 | 15,495 | 9,343 | 5,277 |
| 1957 | 16,575 | 16,040 | 6,251 |
| 1958 | 17,846 | 7,553 | 4,784 |
| 1959 | 19,074 | 6,947 | 5,593 |
| 1960 | 21,095 | 7 436 | 5,587 |
| 1961 | 22,992 | 6,696 | 5,285 |
| 1962 | 26,236 | 8,218 | 5,833 |
| 1963 | 28,794 | 9,640 | 6,344 |
| 1964 | 33,055 | 11,965 | 6,171 |
| 1965 | 38,162 | 16,654 | 6,453 |
| 1966 | 44,400 | 23,637 | 4,926 |
| 1967 | 50,884 | 30,853 | 6,386 |

[a]This table taken from Atkinson, et al (1970), p. 192.

TABLE I-8

Distribution of Highly Qualified Manpower Residing in Canada by

Field of Study at Highest Degree & Labour Force Status

| Field of Study | Employee | Self-Employed | Student | House-wife | Retired | Other | Not Stated |
|---|---|---|---|---|---|---|---|
| Architecture | 40.6 | 56.2 | 0.5 | 0.2 | 1.5 | 0.4 | 0.5 |
| Engineering--Total | 89.1 | 6.1 | 2.9 | 0.0 | 0.9 | 0.5 | 0.4 |
| Aeronautical | 90.6 | 2.2 | 5.4 | 0.0 | 0.9 | 0.9 | 0.0 |
| Ceramic | 95.6 | 2.7 | 0.9 | 0.0 | 0.9 | 0.0 | 0.0 |
| Chemical | 89.1 | 4.9 | 2.6 | 0.1 | 0.6 | 0.4 | 2.4 |
| Civil | 86.5 | 8.5 | 3.3 | 0.0 | 1.0 | 0.5 | 0.2 |
| Electrical | 93.2 | 3.4 | 2.0 | 0.0 | 0.9 | 0.3 | 0.1 |
| Eng. Sc. | 87.3 | 2.9 | 9.0 | 0.0 | 0.0 | 0.6 | 0.2 |
| Geological | 80.5 | 11.9 | 5.8 | 0.0 | 0.4 | 0.9 | 0.4 |
| Industrial | 86.4 | 6.1 | 5.4 | 0.3 | 0.0 | 1.7 | 0.0 |
| Marine | 97.1 | 0.0 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 |
| Materials | 82.1 | 3.6 | 10.7 | 0.0 | 3.6 | 0.0 | 0.0 |
| Mechanical | 89.9 | 6.8 | 1.6 | 0.0 | 1.1 | 0.4 | 0.1 |
| Metallurgical | 89.9 | 3.0 | 5.5 | 0.0 | 0.7 | 0.7 | 0.3 |
| Mining | 81.0 | 12.5 | 3.3 | 0.0 | 1.3 | 1.7 | 0.2 |
| Nuclear | 72.2 | 5.6 | 22.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| Petroleum | 98.3 | 0.8 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 |
| Surveying | 72.4 | 24.1 | 3.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| Textile | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Transport | 88.9 | 0.0 | 11.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Eng. N.E.S. | 86.6 | 8.1 | 4.5 | 0.0 | 0.7 | 0.0 | 0.2 |
| Physical Science--Total | 82.1 | 3.4 | 12.2 | 0.6 | 0.7 | 0.7 | 0.3 |
| Chemistry | 83.1 | 1.2 | 13.7 | 0.5 | 0.7 | 0.5 | 0.3 |
| Atm., Hydro., Litho. | 83.0 | 9.2 | 6.2 | 0.4 | 0.4 | 0.6 | 0.1 |
| Mathematics | 84.2 | 0.9 | 11.3 | 1.2 | 1.3 | 0.5 | 0.4 |
| Physics | 80.5 | 1.1 | 15.6 | 0.6 | 0.7 | 1.3 | 0.1 |
| Phys. Sc. N.E.S. | 43.6 | 53.2 | 1.1 | 0.0 | 1.1 | 0.0 | 1.1 |

TABLE I-8 (Continued)

| Field of Study | Employee | Self-Employed | Student | House-wife | Retired | Other | Not Stated |
|---|---|---|---|---|---|---|---|
| Life Science--Total | 79.3 | 11.6 | 6.9 | 0.4 | 0.9 | 0.4 | 0.4 |
| Agriculture | 84.6 | 10.4 | 3.0 | 0.4 | 0.9 | 0.5 | 0.3 |
| Biology | 84.3 | 0.7 | 12.7 | 0.6 | 0.8 | 0.6 | 0.3 |
| Forestry | 87.0 | 1.9 | 9.5 | 0.0 | 1.0 | 0.1 | 0.4 |
| Veterinary | 41.7 | 54.8 | 0.9 | 0.2 | 0.9 | 0.3 | 1.2 |
| Life Science N.E.S. | 75.0 | 0.0 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Social Science--Total | 88.9 | 1.8 | 3.7 | 3.0 | 1.1 | 1.2 | 0.2 |
| Ec. & Stat. | 92.2 | 2.7 | 4.1 | 0.1 | 0.7 | 0.1 | 0.2 |
| Psych. | 95.1 | 0.0 | 3.9 | 1.0 | 0.0 | 0.0 | 0.0 |
| Sociology | 92.2 | 1.6 | 4.7 | 1.6 | 0.0 | 0.0 | 0.0 |
| Social Work | 81.0 | 0.7 | 2.2 | 9.7 | 1.8 | 4.2 | 0.5 |
| Social S. N.E.S. | 89.5 | 1.4 | 5.5 | 1.4 | 2.3 | 0.0 | 0.0 |
| Other Fields--Total | 88.3 | 3.9 | 3.4 | 1.1 | 2.2 | 0.7 | 0.3 |
| Not Stated | 75.6 | 8.6 | 5.4 | 0.9 | 2.6 | 0.9 | 5.9 |
| Final Total | 84.5 | 7.7 | 5.1 | 0.4 | 1.0 | 0.6 | 0.6 |

TABLE I-9

Estimates of HQM Working for Employers and Residing in Canada,
Median Annual Rate of Earnings from Principal Employment
by Field of Principal Employment and Sex

| Field of Employment | MALES | | FEMALES | | Insufficient Information | Total |
|---|---|---|---|---|---|---|
| | Number Reporting | Median | Number Reporting | Median | | |
| Architecture | 348 | $10,800 | 2 | $7,800 | - | 305 |
| Engineering | 13,369 | 11,300 | 24 | 8,700 | 6 | 13,399 |
| Physical Science | 3,826 | 11,300 | 212 | 8,625 | 2 | 4,040 |
| Life Science | 2,096 | 10,500 | 93 | 7,560 | 2 | 2,191 |
| Social Science | 2,442 | 12,000 | 390 | 8,000 | 1 | 2,833 |
| Other Fields | 2,814 | 10,100 | 128 | 8,000 | 2 | 2,944 |
| Not Stated | 1,230 | 10,816 | 35 | 8,400 | 4 | 1,269 |
| Final Total | 26,125 | 11,200 | 884 | 8,400 | 17 | 27,026 |

labour force and 424,759 (or 49.25%) were classified as dependents. The occupational mix of those who intended to join the labour force underwent a significant change in this period. The proportion of immigrants with "professional and technical" intentions went up to 25.2% from 11.2% in 1959. Those in the fields of "managerial" and "clerical" increased from 1.4% to 3.3% and 10.5% to 16.9%, respectively. Immigrants in the occupational groups of "construction, manufacturing and mechanical" rose from 23.8% to 31.3%.

On the other hand, labourers fell from 18.6% to 2.2%. Service and recreational workers went down 8% and farmers and farm workers decreased from 10.0% to 2.4%. The other occupational groups remained relatively constant.

Among the professional and technical personnel, teachers account for 24% of the entire group. Health professionals make up 22%. While the science technician proportion increased considerably from the early 1960s, the engineer proportion remained stable from 1962. Tables I-10, I-11 and I-12 provide more detailed information.

3. <u>Canadian emigration and estimated emigrants from Ontario to the United States</u>

Canada does not have official records of any kind regarding the outflow of manpower to the United States. In order to obtain an estimate of Canadian emigration to the United States, data were collected from the United States Department

TABLE I-10

Intended Occupations of Immigrants to Ontario 1959-1970

| Occupation | 1959 | | 1960 | | 1961 | | 1962 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| All Occupations | 27,561 | 100 | 27,621 | 100 | 17,495 | 100 | 17,968 | 100 |
| Managerial | 392 | 1.422 | 405 | 1.466 | 417 | 2.384 | 530 | 2.950 |
| Professional and technical | 3,074 | 11.153 | 3,276 | 11.861 | 2,946 | 16.839 | 3,719 | 10.698 |
| Clerical | 2,899 | 10.519 | 3,137 | 11.357 | 2,266 | 12.952 | 2,511 | 13.915 |
| Transportation | 361 | 1.310 | 417 | 1.510 | 197 | 1.126 | 172 | 0.957 |
| Communication | 127 | 0.461 | 198 | 0.717 | 96 | 1.549 | 67 | 0.373 |
| Commercial | 1,048 | 3.802 | 1,143 | 4.138 | 612 | 3.498 | 547 | 3.044 |
| Financial | 89 | 0.323 | 68 | 0.246 | 40 | 0.229 | 83 | 0.462 |
| Service and recreational | 4,775 | 17.325 | 4,337 | 15.702 | 3,162 | 18.074 | 2,807 | 15.622 |
| Farming | 2,751 | 9.981 | 2,857 | 10.344 | 1,172 | 6.699 | 861 | 4.792 |
| Logging | 35 | 0.120 | 65 | 0.235 | 17 | 0.097 | 10 | 0.056 |
| Fishing, hunting, trapping | 3 | 0.011 | 6 | 0.022 | 1 | 0.006 | 4 | 0.022 |
| Mining | 128 | 0.464 | 336 | 1.216 | 52 | 0.297 | 49 | 0.273 |
| Construction | 6,557 | 23.791 | 7,070 | 25.596 | 4,146 | 23.698 | 1,399 | 7.786 |
| Manufacturing and mechanical | | | | | | | 3,530 | 19.646 |
| Labourers | 5,134 | 18.628 | 4,161 | 15.065 | 2,340 | 13.375 | 1,651 | 9.189 |
| Occupation not stated | 188 | 0.682 | 145 | 0.525 | 31 | 0.177 | 28 | 0.156 |
| Dependents | 28,415 | | 26,870 | | 19,023 | | 19,242 | |
| Total Immigration | 55,976 | | 54,491 | | 36,518 | | 37,210 | |

Source: "Immigration Statistics", 1959-1965, Table 5. Department of Citizenship & Immigration, Immigration Branch
"Immigration Statistics", 1966-1970, Canada Immigration Division, Department of Manpower & Immigration, 1966, Table 6; 1967-1970 Table 7.

TABLE I-10 (Continued)

| Occupation | 1963 | | 1964 | | 1965 | | 1966 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| All Occupations | 23,849 | 100 | 30,083 | 100 | 39,512 | 100 | 53,207 | 100 |
| Managerial | 591 | 2.478 | 631 | 2.098 | 776 | 1.964 | 1,077 | 2.024 |
| Professional and technical | 4,605 | 19.309 | 5,564 | 18.495 | 7,284 | 18.435 | 10,494 | 19.723 |
| Clerical | 3,321 | 13.925 | 4,168 | 13.855 | 5,308 | 13.434 | 7,070 | 13.288 |
| Transportation | 224 | 0.939 | 301 | 1.004 | 468 | 1.184 | 687 | 1.291 |
| Communication | 202 | 0.423 | 112 | 0.372 | 147 | 0.032 | 290 | 0.545 |
| Commercial | 742 | 3.111 | 1,001 | 3.327 | 1,297 | 3.283 | 1,687 | 3.171 |
| Financial | 55 | 0.231 | 42 | 0.140 | 89 | 0.225 | 125 | 0.235 |
| Service and recreational | 2,994 | 12.554 | 3,230 | 10.737 | 3,866 | 9.784 | 4,277 | 8.038 |
| Farming | 1,152 | 4.830 | 1,157 | 3.846 | 1,213 | 3.070 | 1,740 | 3.270 |
| Logging | 9 | 0.038 | 23 | 0.076 | 88 | 0.223 | 82 | 0.154 |
| Fishing, hunting, trapping | 1 | 0.004 | 4 | 0.013 | 3 | 0.008 | 10 | 0.019 |
| Mining | 65 | 0.274 | 58 | 0.193 | 88 | 0.223 | 152 | 0.286 |
| Construction | 2,083 | 8.734 | 2,831 | 9.411 | 3,964 | 10.032 | 5,746 | 10.799 |
| Manufacturing and mechanical | 5,749 | 24.106 | 7,148 | 23.761 | 9,901 | 25.058 | 14,223 | 26.731 |
| Labourers | 2,115 | 8.868 | 3,672 | 12.206 | 4,805 | 12.161 | 5,095 | 9.576 |
| Occupation not stated | 42 | 0.176 | 140 | 0.465 | 215 | 0.544 | 452 | 0.850 |
| Dependents | 25,367 | | 31,385 | | 40,190 | | 54,414 | |
| Total Immigration | 49,216 | | 61,468 | | 79,702 | | 107,621 | |

TABLE I-10 (Continued)

| Occupation | 1967 | | 1968 | | 1969 | | 1970 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| All occupations | 62,043 | 100 | 50,048 | 100 | 45,808 | 100 | 42,573 | 100 |
| Managerial | 1,350 | 2.176 | 1,029 | 2.056 | 1,136 | 2.480 | 1,416 | 3.326 |
| Professional & technical | 13,985 | 22.541 | 13,749 | 27.472 | 13,321 | 29.080 | 10,741 | 25.230 |
| Clerical | 8,616 | 13.887 | 6,804 | 13.595 | 7,119 | 15.541 | 7,209 | 16.933 |
| Transportation | 597 | 0.962 | 421 | 0.841 | 356 | 0.777 | 338 | 0.794 |
| Communication | 279 | 0.450 | 185 | 0.370 | 138 | 0.301 | 130 | 0.305 |
| Commercial | 1,536 | 2.476 | 1,406 | 2.809 | 1,554 | 3.392 | 1,531 | 3.596 |
| Financial | 168 | 0.271 | 272 | 0.543 | 305 | 0.666 | 256 | 0.601 |
| Service & recreational | 5,409 | 8.718 | 4,927 | 9.845 | 4,764 | 10.400 | 4,099 | 9.628 |
| Farming | 1,680 | 2.708 | 1,730 | 3.457 | 1,091 | 2.382 | 1,009 | 2.370 |
| Logging | 109 | 0.176 | 39 | 0.078 | 26 | 0.057 | 16 | 0.038 |
| Fishing, hunting, trapping | 10 | 0.016 | 6 | 0.012 | 2 | 0.004 | 9 | 0.021 |
| Mining | 140 | 0.226 | 212 | 0.424 | 240 | 0.524 | 121 | 0.284 |
| Construction | 6,059 | 9.763 | 4,709 | 9.409 | 3,669 | 8.010 | 3,706 | 8.705 |
| Manufacturing & mechanical | 15,124 | 24.377 | 12,887 | 25.749 | 10,197 | 22.260 | 9,612 | 22.578 |
| Labourers | 6,150 | 9.912 | 1,619 | 3.235 | 1,179 | 2.574 | 956 | 2.246 |
| Occupation not stated | 833 | 1.343 | 53 | 0.106 | 711 | 1.552 | 1,424 | 3.345 |
| Dependents | 54,807 | | 46,107 | | 40,780 | | 38,159 | |
| Total Immigration | 116,850 | | 96,155 | | 86,588 | | 0,732 | |

TABLE I-11

Immigration of Professional & Technical Personnel to Ontario as Percentage of Total Intended Occupational Groups

| Profession | (inclusive) 1946-52 | | (inclusive) 1953-55 | | 1956 | | 1957 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| All occupations | 222,522 | 100 | 121,281 | 100 | 48,781 | 100 | 76,548 | 100 |
| Professional & Technical | 8,636 | 3.881 | 12,195 | 10.055 | 4,758 | 9.754 | 7,735 | 10.105 |
| Engineers | 1,693 | 0.761 | 2,705 | 2.230 | 868 | 1.779 | 1,483 | 1.937 |
| Physical Scientists | n.a. | | n.a. | | n.a. | | n.a. | |
| Biologists | n.a. | | n.a. | | n.a. | | n.a. | |
| Teachers | n.a. | | 1,059 | 0.873 | 469 | 0.961 | 660 | 0.862 |
| Health Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Physicians & Surgeons | n.a. | | 360 | 0.297 | 143 | 0.293 | 219 | 0.286 |
| Nurses - graduate | 1,269 | 0.570 | 2,416 | 1.992 | 775 | 1.589 | 1,016 | 1.327 |
| Therapists | n.a. | | n.a. | | n.a. | | n.a. | |
| Medical & Dental Technicians | n.a. | | 475 | 0.392 | 213 | 0.437 | 425 | 0.555 |
| Others | n.a. | | n.a. | | n.a. | | n.a. | |
| Law Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Religious Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Other Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Draftsmen | 967 | 0.435 | 1,296 | 1.069 | 777 | 1.593 | 1,397 | 1.825 |
| Accountants | 397 | 0.178 | 575 | 0.474 | 208 | 0.426 | 364 | 0.476 |
| Social Workers | n.a. | | n.a. | | n.a. | | n.a. | |
| Science Technicians | n.a. | | n.a. | | n.a. | | n.a. | |
| Others, N.E.S. | 4,310 | 1.937 | 3,309 | 2.728 | 1,305 | 2.675 | 2,171 | 2.836 |

Source: "Population Statistics", Ontario 1969, Economic Analysis Branch, Economic & Statistical Services Division, Department of Treasury & Economics, Table 51. Immigrants Admitted to Ontario by Intended Occupations, 1946-67. "Ontario Statistical Review 1969," Supplement to Ontario Economic Review, Department of Treasury and Economics, p. 46. "Immigration Statistics Canada 1969 & 1970," Canada Immigration Division, Department of Manpower and Immigration, Table 7.

TABLE I-11 (Continued)

| Profession | 1958 Number | 1958 % | 1959 Number | 1959 % | 1960 Number | 1960 % | 1961 Number | 1961 % | 1962 Number | 1962 % |
|---|---|---|---|---|---|---|---|---|---|---|
| All occupations | 31,581 | 100 | 27,561 | 100 | 27,621 | 100 | 17,495 | 100 | 17,968 | 100 |
| Professional & Technical | 3,230 | 10.228 | 3,074 | 11.153 | 3,276 | 11.861 | 2,946 | 16.839 | 3,719 | 20.698 |
| Engineers | 434 | 1.374 | 340 | 1.234 | 295 | 1.068 | 222 | 1.269 | 446 | 2.482 |
| Physical Scientists | n.a. | | n.a. | | n.a. | | n.a. | | 173 | 0.963 |
| Biologists | n.a. | | n.a. | | n.a. | | n.a. | | 38 | 0.211 |
| Teachers | 433 | 1.371 | 410 | 1.488 | 488 | 1.767 | 479 | 2.738 | 536 | 2.983 |
| Health Professionals | n.a. | | n.a. | | n.a. | | n.a. | | 1,436 | 7.992 |
| Physicians & Surgeons | 129 | 0.408 | 163 | 0.591 | 154 | 0.558 | 153 | 0.875 | 142 | 0.790 |
| Nurses - graduate | 627 | 1.985 | 619 | 2.246 | 748 | 2.708 | 710 | 4.058 | 1,017 | 5.660 |
| Therapists | n.a. | | n.a. | | n.a. | | n.a. | | 89 | 0.495 |
| Medical & Dental Technicians | 163 | 0.516 | 161 | 0.584 | 200 | 0.724 | 177 | 1.012 | 106 | 0.590 |
| Others | n.a. | | n.a. | | n.a. | | n.a. | | 82 | 0.456 |
| Law Professionals | n.a. | | n.a. | | n.a. | | n.a. | | 13 | 0.072 |
| Religious Professionals | n.a. | | n.a. | | n.a. | | n.a. | | 176 | 0.980 |
| Other Professionals | n.a. | | n.a. | | n.a. | | n.a. | | 901 | 5.014 |
| Draftsmen | 268 | 0.849 | 192 | 0.697 | 232 | 0.840 | 159 | 0.909 | 232 | 1.291 |
| Accountants | 132 | 0.418 | 119 | 0.432 | 120 | 0.434 | 96 | 0.549 | 132 | 0.735 |
| Social Workers | n.a. | | n.a. | | n.a. | | n.a. | | 24 | 0.134 |
| Science Technicians | n.a. | | n.a. | | n.a. | | n.a. | | 81 | 0.451 |
| Others, N.E.S. | 1,044 | 3.306 | 1,070 | 3.882 | 1,039 | 3.762 | 950 | 5.430 | 432 | 2.404 |

TABLE I-11 (Continued)

| Profession | 1963 | | 1964 | | 1965 | | 1966 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| All occupations | 23,849 | 100 | 30,083 | 100 | 39,512 | 100 | 53,207 | 100 |
| Professional & Technical | 4,605 | 19.309 | 5,564 | 18.495 | 7,284 | 18.435 | 10,494 | 19.723 |
| Engineers | 612 | 2.566 | 715 | 2.377 | 971 | 2.457 | 1,465 | 2.753 |
| Physical Scientists | 172 | 0.721 | 244 | 0.811 | 339 | 0.858 | 440 | 0.827 |
| Biologists | 45 | 0.189 | 54 | 0.180 | 83 | 0.210 | 115 | 0.216 |
| Teachers | 655 | 2.746 | 891 | 2.962 | 1,270 | 3.214 | 1,759 | 3.306 |
| Health Professionals | 1,756 | 7.363 | 1,820 | 6.050 | 2,040 | 5.163 | 2,616 | 4.917 |
| Physicians & Surgeons | 191 | 0.801 | 185 | 0.615 | 207 | 0.524 | 309 | 0.581 |
| Nurses - graduate | 1,218 | 5.107 | 1,131 | 3.760 | 1,427 | 3.612 | 1,881 | 3.535 |
| Therapists | 75 | 0.314 | 82 | 0.273 | 90 | 0.228 | 122 | 0.229 |
| Medical and Dental Technicians | 131 | 0.549 | 111 | 0.369 | 161 | 0.407 | 190 | 0.357 |
| Others | 141 | 0.591 | 311 | 1.034 | 155 | 0.392 | 114 | 0.214 |
| Law Professionals | 12 | 0.050 | 13 | 0.043 | 21 | 0.053 | 31 | 0.058 |
| Religious Professionals | 163 | 0.683 | 160 | 0.532 | 162 | 0.410 | 197 | 0.370 |
| Other Professionals | 1,190 | 4.990 | 1,667 | 5.541 | 2,398 | 6.069 | 3,871 | 7.275 |
| Draftsmen | 415 | 1.740 | 530 | 1.762 | 798 | 2.020 | 1,292 | 2.428 |
| Accountants | 118 | 0.495 | 161 | 0.535 | 225 | 0.569 | 350 | 0.658 |
| Social Workers | 30 | 0.126 | 28 | 0.093 | 69 | 0.175 | 79 | 0.148 |
| Science Technicians | 152 | 0.637 | 342 | 1.137 | 526 | 1.331 | 926 | 1.740 |
| Others, N.E.S. | 475 | 1.992 | 606 | 2.014 | 780 | 1.974 | 1,224 | 2.300 |

TABLE I-11 (Continued)

| Profession | 1967 | | 1968 | | 1969 | | 1970 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| All occupations | 62,043 | 100 | 50,048 | 100 | 45,808 | 100 | 42,573 | 100 |
| Professional & Technical | 13,985 | 22.541 | 13,749 | 27.472 | 13,321 | 29.080 | 10,741 | 25.230 |
| Engineers | 1,755 | 2.829 | 1,400 | 2.797 | 1,488 | 3.248 | 1,147 | 2.694 |
| Physical Scientists | 542 | 0.874 | 523 | 1.045 | 495 | 1.081 | 375 | 0.881 |
| Biologists | 173 | 0.279 | 262 | 0.523 | 285 | 0.622 | 210 | 0.493 |
| Teachers | 2,812 | 4.532 | 3,299 | 6.592 | 3,614 | 7.890 | 2,574 | 6.046 |
| Health Professionals | 3,317 | 5.346 | 3,383 | 6.760 | 3,393 | 7.407 | 2,418 | 5.680 |
| Physicians and Surgeons | 437 | 0.704 | 513 | 1.025 | 570 | 1.244 | 459 | 1.078 |
| Nurses - graduate | 2,299 | 3.705 | 1,868 | 3.732 | 1,917 | 4.185 | 1,125 | 2.643 |
| Therapists | 166 | 0.268 | 89 | 0.178 | 76 | 0.166 | 61 | 0.143 |
| Medical and Dental Technicians | 231 | 0.372 | 625 | 1.249 | 555 | 1.212 | 493 | 1.158 |
| Others | 184 | 0.297 | 288 | 0.575 | 275 | 0.600 | 280 | 0.658 |
| Law Professionals | 38 | 0.061 | 54 | 0.108 | 26 | 0.057 | 33 | 0.078 |
| Religious Professionals | 164 | 0.264 | 151 | 0.302 | 143 | 0.312 | 151 | 0.355 |
| Other Professionals | 5,184 | 8.355 | 4,677 | 9.345 | 3,877 | 8.464 | 3,833 | 9.003 |
| Draftsmen | 1,436 | 2.315 | 1,133 | 2.264 | 573 | 1.251 | 617 | 1.449 |
| Accountants | 388 | 0.625 | 289 | 0.577 | 268 | 0.585 | 214 | 0.503 |
| Social Workers | 145 | 0.234 | 201 | 0.402 | 228 | 0.498 | 198 | 0.465 |
| Science Technicians | 1,472 | 2.373 | 1,230 | 2.458 | 1,104 | 2.410 | 1,180 | 2.772 |
| Others, N.E.S. | 1,743 | 2.809 | 1,824 | 3.645 | 1,704 | 3.720 | 1,624 | 3.815 |

TABLE I-12

Immigration of Professional & Technical Personnels to Ontario 1946-1970

| Profession | 1946-52 (inclusive) | | 1953-55 (inclusive) | | 1956 | | 1957 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Professional & Technical | 8,636 | 100 | 12,195 | 100 | 4,758 | 100 | 7,735 | 100 |
| Engineers | 1,693 | 19.604 | 2,750 | 22.181 | 868 | 18,243 | 1,483 | 19.173 |
| Physical Scientists | n.a. | | n.a. | | n.a. | | n.a. | |
| Biologists | n.a. | | n.a. | | n.a. | | n.a. | |
| Teachers | n.a. | | 1,059 | 8.684 | 469 | 9.857 | 660 | 8.533 |
| Health Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Physicians & Surgeons | n.a. | | 360 | 2.952 | 143 | 3.005 | 219 | 2.831 |
| Nurses - graduate | 1,269 | 14.694 | 2,416 | 19.811 | 775 | 16.288 | 1,016 | 13.135 |
| Therapists | n.a. | | n.a. | | n.a. | | n.a. | |
| Medical & Dental Technicians | n.a. | | 475 | 3.895 | 213 | 4.477 | 425 | 5.495 |
| Others | n.a. | | n.a. | | n.a. | | n.a. | |
| Law Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Religious Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Other Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Draftsmen | 967 | 11.197 | 1,296 | 10.627 | 777 | 16.330 | 1,397 | 18.061 |
| Accountants | 397 | 4.597 | 575 | 4.715 | 208 | 4.372 | 364 | 4.706 |
| Social Workers | n.a. | | n.a. | | n.a. | | n.a. | |
| Science Technicians | n.a. | | n.a. | | n.a. | | n.a. | |
| Others, N.E.S. | 4,310 | 49.907 | 3,309 | 27.134 | 1,305 | 27.427 | 2,171 | 28.067 |

Source: "Population Statistics, Ontario 1969" 1946-1967, Economic Analysis Branch, Economic & Statistical Services Division, Department of Treasury & Economics, Table 51, Immigrants Admitted to Ontario by Intended Occupations, 1946-67.
"Ontario Statistical Review 1969" 1968, Supplement to Ontario Economic Review, Department of Treasury and Economics, p. 46.
"Immigration Statistics Canada 1969 & 1970" 1969-70, Canada Immigration Division, Department of Manpower and Immigration, Table 7.

TABLE I-12 (Continued)

| Profession | 1958 | | 1959 | | 1960 | | 1961 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Professional & Technical | 3,230 | 100 | 3,074 | 100 | 3,276 | 100 | 2,946 | 100 |
| Engineers | 434 | 13.437 | 340 | 11.061 | 295 | 9.005 | 222 | 7.536 |
| Physical Scientists | n.a. | | n.a. | | n.a. | | n.a. | |
| Biologists | n.a. | | n.a. | | n.a. | | n.a. | |
| Teachers | 433 | 13.406 | 410 | 13.338 | 488 | 14.896 | 479 | 16.259 |
| Health Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Physicians & Surgeons | 129 | 3.994 | 163 | 5.303 | 154 | 4.701 | 153 | 5.193 |
| Nurses - graduate | 627 | 19.412 | 619 | 20.137 | 748 | 22.833 | 710 | 24.100 |
| Therapists | n.a. | | n.a. | | n.a. | | n.a. | |
| Medical & Dental Technicians | 163 | 5.046 | 161 | 5.237 | 200 | 6.105 | 177 | 6.008 |
| Others | n.a. | | n.a. | | n.a. | | n.a. | |
| Law Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Religious Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Other Professionals | n.a. | | n.a. | | n.a. | | n.a. | |
| Draftsmen | 268 | 8.297 | 192 | 6.246 | 232 | 7.082 | 159 | 5.397 |
| Accountants | 132 | 4.087 | 119 | 3.871 | 120 | 3.663 | 96 | 3.259 |
| Social Workers | n.a. | | n.a. | | n.a. | | n.a. | |
| Science Technicians | n.a. | | n.a. | | n.a. | | n.a. | |
| Others, N.E.S. | 1,044 | 32.322 | 1,070 | 34.808 | 1,039 | 31.716 | 950 | 32.247 |

TABLE I-12 (Continued)

| Profession | 1962 | | 1963 | | 1964 | | 1965 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Professional & Technical | 3,719 | 100 | 4,605 | 100 | 5,564 | 100 | 7,284 | 100 |
| Engineers | 446 | 11.992 | 612 | 13.290 | 715 | 12.850 | 971 | 13.331 |
| Physical Scientists | 173 | 4.652 | 172 | 3.735 | 244 | 4.385 | 339 | 4.654 |
| Biologists | 38 | 1.022 | 45 | 0.977 | 54 | 0.971 | 83 | 1.139 |
| Teachers | 536 | 14.412 | 655 | 14.224 | 891 | 16.014 | 1,270 | 17.435 |
| Health Professionals | 1,436 | 38.613 | 1,756 | 38.132 | 1,820 | 32.710 | 2,040 | 28.007 |
| Physicians & Surgeons | 142 | 3.818 | 191 | 4.148 | 185 | 3.325 | 207 | 2.842 |
| Nurses - graduate | 1,017 | 27.346 | 1,218 | 26.450 | 1,131 | 20.327 | 1,427 | 19.591 |
| Therapists | 89 | 2.393 | 75 | 1.629 | 82 | 1.474 | 90 | 1.236 |
| Medical & Dental Technicians | 106 | 2.850 | 131 | 2.845 | 111 | 1.995 | 161 | 2.210 |
| Others | 82 | 2.205 | 141 | 3.062 | 311 | 5.590 | 155 | 2.128 |
| Law Professionals | 13 | 0.350 | 12 | 0.261 | 13 | 0.234 | 21 | 0.288 |
| Religious Professionals | 176 | 4.732 | 163 | 3.540 | 160 | 2.876 | 162 | 2.224 |
| Other Professionals | 901 | 24.227 | 1,190 | 25.841 | 1,667 | 29.960 | 2,398 | 32.921 |
| Draftsmen | 232 | 6.238 | 415 | 9.012 | 530 | 9.526 | 798 | 10.956 |
| Accountants | 132 | 3.549 | 118 | 2.562 | 161 | 2.894 | 225 | 3.089 |
| Social Workers | 24 | 0.645 | 30 | 0.651 | 28 | 0.503 | 69 | 0.947 |
| Science Technicians | 81 | 2.178 | 152 | 3.301 | 342 | 6.147 | 526 | 7.221 |
| Others, N.E.S. | 432 | 11.616 | 475 | 10.315 | 606 | 10.891 | 780 | 10.708 |

TABLE I-12 (Continued)

| | 1966 | | 1967 | | 1968 | | 1969 | | 1970 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % | Number | % |
| Professional & Technical | 10,494 | 100 | 13,985 | 100 | 13,749 | 100 | 13,321 | 100 | 10,741 | 100 |
| Engineers | 1,465 | 13.960 | 1,755 | 12.549 | 1,400 | 10.183 | 1,488 | 11.170 | 1,147 | 10.679 |
| Physical Scientists | 440 | 4.193 | 542 | 3.876 | 523 | 3.804 | 495 | 3.716 | 375 | 3.491 |
| Biologists | 115 | 1,096 | 173 | 1.237 | 262 | 1.906 | 285 | 2.140 | 210 | 1.955 |
| Teachers | 1,759 | 16.762 | 2,812 | 20.107 | 3,299 | 23.994 | 3,614 | 27.130 | 2,574 | 23.964 |
| Health Professionals | 2,616 | 24.929 | 3,317 | 23.718 | 3,383 | 24.605 | 3,393 | 25.471 | 2,418 | 22.512 |
| Physicians & Surgeons | 309 | 2.945 | 437 | 3.125 | 513 | 3.731 | 570 | 4.279 | 459 | 4.273 |
| Nurses - graduate | 1,881 | 17.925 | 2,299 | 16.439 | 1,868 | 13.586 | 1,917 | 14.391 | 1,125 | 10.474 |
| Therapists | 122 | 1.163 | 166 | 1.187 | 89 | 0.647 | 76 | 0.571 | 61 | 0.568 |
| Medical & Dental Technicians | 190 | 1.811 | 231 | 1.652 | 625 | 4.546 | 555 | 4.166 | 493 | 4.590 |
| Others | 114 | 1.086 | 184 | 1.316 | 288 | 2.095 | 275 | 2.064 | 280 | 2.607 |
| Law Professionals | 31 | 0.295 | 38 | 0.272 | 54 | 0.393 | 26 | 0.195 | 33 | 0.307 |
| Religious Professionals | 197 | 1.877 | 164 | 1.173 | 151 | 1.098 | 143 | 1.074 | 151 | 0.406 |
| Other Professionals | 3,871 | 36.888 | 5,184 | 37.068 | 4,677 | 34.017 | 3,877 | 29.104 | 3,833 | 35.686 |
| Draftsmen | 1,292 | 12.312 | 1,436 | 10.268 | 1,133 | 8.241 | 573 | 4.302 | 617 | 5,744 |
| Accountants | 350 | 3.335 | 388 | 2.774 | 289 | 2.102 | 268 | 2.012 | 214 | 1.992 |
| Social Workers | 79 | 0.753 | 145 | 1.037 | 201 | 1.462 | 228 | 1.712 | 198 | 1.843 |
| Science Technicians | 926 | 8.824 | 1,472 | 10.526 | 1,230 | 8.946 | 1,104 | 8.288 | 1,180 | 10.986 |
| Others, N.E.S. | 1,224 | 11.664 | 1,743 | 12.463 | 1,824 | 13.266 | 1,704 | 12.792 | 1,624 | 15.120 |

of Justice, Immigration and Naturalization Service.

Table I-13 shows the changes in the numbers of "professional and technical" personnel emigrating to the United States from Canada, and in the proportion they constitute of total emigration to the U. S. This group amounted to 36% of the total number of emigrating workers in 1970, about 50% higher than their proportion in 1960. The annual increase was gradual, except for the peak in 1967-68.

Table I-14 contains estimates of the total number of Ontario residents emigrating to the United States during 1962-70. Roughly speaking, they accounted for 45% of all Canadian residents emigrating to the U.S., but were a higher percentage during the late 1960s except for 1970.

It is assumed that the percentages of emigrants in different occupational groups in Ontario are the same as for Canada as a whole. The percentages calculated in Table I-15 were applied to Table I-16 to estimate the number and proportion of Ontario emigrants engaging in different occupations.

## C. Overview of Methodology for Projecting Manpower Requirements

### 1. Introduction

For reasons given in Part A (Chapter V), it was decided to use the occupational co-efficient approach where possible in projecting manpower requirements. To use this method it is necessary to have data on output for the industry groupings. In the case of the goods-producing sector there are data on output

TABLE I-13

Canadian Emigrants to the United States by Selected Occupational Groups, 1960-70

| Profession | 1960 | | 1961 | | 1962 | | 1963 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| All emigrants | 46,668 | | 47,470 | | 44,272 | | 50,509 | |
| All dependents | 22,548 | | 23,338 | | 21,376 | | 25,007 | |
| All occupations | 24,120 | 100 | 24,132 | 100 | 22,896 | 100 | 25,502 | 100 |
| Professional & Technical | 5,768 | 23.914 | 5,562 | 23.048 | 5,561 | 24.488 | 6,398 | 25.088 |
| Engineers | 1,073 | 4.449 | 811 | 3.360 | 816 | 3.564 | 894 | 3.506 |
| Physical Scientists | 144 | 0.597 | 179 | 0.742 | 166 | 0.725 | 177 | 0.694 |
| Biologists | 24 | 0.100 | 21 | 0.087 | 27 | 0.118 | 43 | 0.169 |
| Teachers | 539 | 2.235 | 575 | 2.383 | 686 | 2.996 | 746 | 2.925 |
| Health Professionals | 1,871 | 7.757 | 1,880 | 7.791 | 1,822 | 7.958 | 2,254 | 8.839 |
| Physicians & Surgeons | 245 | 1.016 | 287 | 1.189 | 280 | 1.223 | 467 | 1.831 |
| Nurses - graduate | 1,372 | 5.688 | 1,316 | 5.453 | 1,259 | 5.499 | 1,456 | 5.709 |
| Therapists | 41 | 0.170 | 37 | 0.153 | 29 | 0.127 | 32 | 0.125 |
| Medical & Dental Technicians | 96 | 0.398 | 113 | 0.468 | 124 | 0.542 | 167 | 0.655 |
| Others | 117 | 0.485 | 127 | 0.526 | 130 | 0.568 | 132 | 0.518 |
| Law Professionals | 20 | 0.083 | 18 | 0.075 | 12 | 0.052 | 19 | 0.075 |
| Religious Professionals | 244 | 1.012 | 283 | 1.173 | 276 | 1.205 | 275 | 1.078 |
| Other Professionals | 1,853 | 7.682 | 1,795 | 7.438 | 1,756 | 7.670 | 1,990 | 7.803 |
| Draftsmen | 294 | 1.219 | 218 | 0.903 | 227 | 0.991 | 253 | 0.992 |
| Accountants | 289 | 1.198 | 295 | 1.222 | 285 | 1.245 | 364 | 1.427 |
| Social Workers | 44 | 0.182 | 54 | 0.224 | 43 | 0.188 | 73 | 0.286 |
| Others, N.E.S. | 1,226 | 5.083 | 1,228 | 5.089 | 1,201 | 5.245 | 1,300 | 5.098 |

Source: United States Department of Justice, Immigration & Naturalization Service. "Immigrant Aliens Admitted to the United States, Whose Country of Last Permanent Residence Was Canada, by Occupation: Years Ending June 30, 1960-1970.

TABLE I-13 (Continued)

| Profession | 1964 | | 1965 | | 1966 | | 1967 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| All emigrants | 51,114 | | 50,035 | | 37,273 | | 34,768 | |
| All dependents | 25,304 | | 24,790 | | 20,001 | | 19,903 | |
| All occupations | 25,810 | 100 | 25,245 | 100 | 17,272 | 100 | 14,765 | 100 |
| Professional & Technical | 6,510 | 25.223 | 6,579 | 26.061 | 5,587 | 32.347 | 5,965 | 40.400 |
| Engineers | 789 | 3.057 | 892 | 3.533 | 852 | 4.933 | 1,196 | 8.100 |
| Physical Scientists | 196 | 0.759 | 205 | 0.812 | 170 | 0.984 | 222 | 1.504 |
| Biologists | 48 | 0.186 | 39 | 0.514 | 27 | 0.156 | 45 | 0.305 |
| Teachers | 852 | 3.301 | 877 | 3.474 | 848 | 4.910 | 773 | 5.235 |
| Health Professionals | 2,282 | 8.842 | 2,172 | 8.604 | 1,904 | 11.024 | 1,937 | 13.119 |
| Physicians & Surgeons | 440 | 1.705 | 380 | 1.505 | 393 | 2.275 | 449 | 3.041 |
| Nurses - graduate | 1,436 | 5.564 | 1,419 | 5.621 | 1,193 | 6.907 | 1,180 | 7.992 |
| Therapists | 41 | 0.159 | 36 | 0.143 | 33 | 0.191 | 34 | 0.230 |
| Medical & Dental Technicians | 195 | 0.756 | 191 | 0.757 | 151 | 0.874 | 154 | 1.043 |
| Others | 170 | 0.659 | 146 | 0.578 | 134 | 0.776 | 120 | 0.813 |
| Law Professionals | 12 | 0.046 | 11 | 0.044 | 10 | 0.058 | 13 | 0.088 |
| Religious Professionals | 308 | 1.193 | 261 | 1.034 | 249 | 1.442 | 175 | 1.863 |
| Other Professionals | 2,023 | 7.838 | 2,122 | 8.406 | 1,527 | 8.841 | 1,504 | 10.186 |
| Draftsmen | 260 | 1.007 | 245 | 0.970 | 162 | 0.938 | 211 | 1.429 |
| Accountants | 363 | 1.406 | 362 | 1.434 | 226 | 1.308 | 177 | 1.199 |
| Social Workers | 66 | 0.256 | 73 | 0.289 | 70 | 0.405 | 75 | 0.508 |
| Others, N.E.S. | 2,334 | 5.169 | 1,442 | 5.712 | 1,069 | 6.189 | 1,041 | 7.050 |

TABLE I-13 (Continued)

| Profession | 1968 | | 1969 | | 1970 | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| All emigrants | 41,716 | | 29,303 | | 26,849 | |
| All dependents | 22,539 | | 15,836 | | 14,346 | |
| All occupations | 19,177 | 100 | 13,467 | 100 | 12,503 | 100 |
| Professional & Technical | 7,117 | 37.112 | 4,821 | 35.799 | 4.573 | 36.575 |
| Engineers | 1,402 | 7.311 | 848 | 6.297 | 857 | 6.854 |
| Physical Scientists | 249 | 1.298 | 173 | 1.285 | 217 | 1.736 |
| Biologists | 42 | 0.219 | 34 | 0.252 | 51 | 0.408 |
| Teachers | 969 | 5.053 | 734 | 5.450 | 704 | 5.631 |
| Health Professionals | 2,154 | 11.232 | 1,456 | 10.812 | 1.295 | 10.358 |
| Physicians & Surgeons | 314 | 1.637 | 236 | 1.752 | 240 | 1.920 |
| Nurses - graduate | 1,478 | 7.707 | 1,006 | 7.470 | 816 | 6.526 |
| Therapists | 56 | 0.292 | 35 | 0.260 | 35 | 0.280 |
| Medical & Dental Technicians | 168 | 0.876 | 100 | 0.743 | 126 | 1.008 |
| Others | 138 | 0.720 | 79 | 0.587 | 78 | 0.624 |
| Law Professionals | 18 | 0.094 | 8 | 0.059 | 13 | 0.104 |
| Religious Professionals | 256 | 1.335 | 240 | 1.782 | 189 | 1.512 |
| Other Professionals | 2,027 | 10.570 | 1,328 | 0.861 | 1,246 | 9.966 |
| Draftsmen | 420 | 2.190 | 233 | 1.730 | 135 | 1.080 |
| Accountants | 283 | 1.476 | 221 | 1.641 | 201 | 1.608 |
| Social Workers | 61 | 0.318 | 41 | 0.304 | 40 | 0.320 |
| Others, N.E.S. | 1,263 | 6.586 | 833 | 6.185 | 870 | 6.958 |

TABLE I-14*

Immigration to the United States through Canadian Ports, 1962-1970

| Year | Total immigration from Canada | | (2) as a percentage of (1) (3) | Immigration of Canadian Residents[a] | |
|---|---|---|---|---|---|
| | Canadian Border (1) | Ontario Border[b] (2) | | Canadian Residents (4) | Estimated Ontario Residents[c] (5) |
| 1962 | 49,167 | 22,584 | 45.93 | 44,272 | 20.335 |
| 1963 | 59,012 | 25,169 | 42.65 | 50.509 | 21,542 |
| 1964 | 63,093 | 27,901 | 44.22 | 51,114 | 22.603 |
| 1965 | 61,592 | 27,347 | 44.40 | 50.035 | 22,215 |
| 1966 | 49,100 | 23,135 | 47.11 | 37,273 | 17.559 |
| 1967 | 46,788 | 23,310 | 49.82 | 34.768 | 17,321 |
| 1968 | 50,959 | 24,609 | 48.29 | 41,716 | 20.145 |
| 1969 | 36,547 | 17,705 | 48.44 | 29.303 | 14,194 |
| 1970 | 36,759 | 16,731 | 45.52 | 26,849 | 12.222 |

a. These figures do not include persons who entered the United States from other countries.

b. Immigrants who entered through ports at Buffalo, N.Y.; Chicago, Illinois (only 1/4 of the reported immigrants takèn); Cleveland, Ohio; Detroit, Mich.; Sault Ste. Marie, Mich.; Thousand Islands Bridge, N.Y.

c. This was estimated by applying the percentage in column (3) to column (4).

Source: United States Department of Justice, Immigration and Naturalization Service. "Immigrants admitted by port of entry - Years ending June 30, 1962-1966."

*Watson & Butorac. "Qualified Manpower, Vol. II," to be published by OISE. 1972.

TABLE I-15

Canadian Emigrants to the United States by Major Occupational Groups, 1960-70

| Occupation | 1960 | | 1961 | | 1962 | | 1963 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Total emigrants | 46,668 | 100 | 47,470 | 100 | 44,272 | 100 | 50,509 | 100 |
| All occupations | 24,120 | 51.684 | 24,132 | 50.836 | 22,896 | 51.717 | 25,502 | 50.492 |
| Professional & Technical | 5,768 | 12.360 | 5,562 | 11.717 | 5,561 | 12.561 | 6,398 | 12.667 |
| Farmers & Farm Managers | 175 | 0.375 | 135 | 0.284 | 119 | 0.269 | 120 | 0.238 |
| Managerial | 1,179 | 2.526 | 1,136 | 2.393 | 1,074 | 2.426 | 1,185 | 2.346 |
| Clerical | 4,781 | 10.245 | 4,744 | 9.994 | 4,394 | 9.925 | 4,928 | 9.757 |
| Sales Workers | 1,262 | 2.704 | 1,310 | 2.760 | 1,256 | 2.837 | 1,350 | 2.673 |
| Craftsmen, Foremen | 4,518 | 9.681 | 4,487 | 9.452 | 3,833 | 8.658 | 4,184 | 8.284 |
| Operators | 2,351 | 5.038 | 2.434 | 5.127 | 2,081 | 4.700 | 2,486 | 4.922 |
| Private Household Workers | 464 | 0.994 | 484 | 1.020 | 339 | 0.766 | 409 | 0.810 |
| Service | 1,561 | 3.345 | 1,702 | 3.585 | 1,974 | 4.459 | 2,093 | 4.144 |
| Farm Labourers | 210 | 0.450 | 188 | 0.396 | 198 | 0.447 | 192 | 0.380 |
| Labourers (except farms and mines) | 1,851 | 3.966 | 1,950 | 4.108 | 2,067 | 4.669 | 2,157 | 4.271 |
| Dependents | 22,548 | 48.316 | 23,338 | 49.164 | 21,376 | 48.283 | 25,007 | 49.510 |

Source: United States Department of Justice, Immigration & Naturalization Service. "Immigrant Aliens Admitted to the United States, whose Country of Last Permanent Residence Was Canada, by Occupation: Years Ended June 30, 1960-1970."

TABLE I-15 (Continued)

| Occupation | 1964 | | 1965 | | 1966 | | 1967 | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Total emigrants | 51,114 | 100 | 50,035 | 100 | 37,273 | 100 | 34,768 | 100 |
| All occupations | 25,810 | 50.495 | 25,245 | 50.455 | 17,272 | 46.340 | 14,765 | 42.756 |
| Professional & Technical | 6,510 | 12.736 | 6,579 | 13.149 | 5,587 | 14.989 | 5,965 | 17.157 |
| Farmers & Farm Managers | 117 | 0.229 | 147 | 0.294 | 85 | 0.228 | 41 | 0.118 |
| Managerial | 1,345 | 2.631 | 1,265 | 2.528 | 1,020 | 2.737 | 949 | 2.730 |
| Clerical | 5,322 | 10.412 | 5,200 | 10.393 | 3,170 | 8.505 | 1,578 | 4.539 |
| Sales Workers | 1,358 | 2.657 | 1,231 | 2.460 | 771 | 2.069 | 473 | 1.360 |
| Craftsmen, Foremen | 4,161 | 8.141 | 4,039 | 8.072 | 2,455 | 6.587 | 2,497 | 7.182 |
| Operators | 2,347 | 4.592 | 2,135 | 4.267 | 1,399 | 3.753 | 1,181 | 3.397 |
| Private Household Workers | 386 | 0.755 | 346 | 0.692 | 218 | 0.585 | 271 | 0.779 |
| Service | 2,210 | 4.324 | 2,014 | 4.025 | 1,235 | 3.313 | 1,140 | 3.279 |
| Farm Labourers | 158 | 0.309 | 137 | 0.274 | 77 | 0.207 | 41 | 0.118 |
| Labourers (except farms and mines) | 1,896 | 3.709 | 2,152 | 4.301 | 1,255 | 3.367 | 729 | 2.097 |
| Dependents | 25,304 | 49.505 | 24,790 | 49.545 | 20,001 | 53.661 | 19,903 | 57.245 |

TABLE I-15 (Continued)

| Occupation | 1968 | | 1969 | | 1970 | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| Total Emigrants | 41,716 | 100 | 29,303 | 100 | 26,849 | 100 |
| All Occupations | 19,117 | 45.972 | 13,467 | 45.957 | 12,503 | 46.567 |
| Professional & Technical | 7,117 | 17.061 | 4,821 | 16.452 | 4,573 | 17.032 |
| Farmers & Farm Managers | 37 | 0.089 | 30 | 0.102 | 34 | 0.127 |
| Managerial | 1,163 | 2.788 | 699 | 2.385 | 659 | 2.454 |
| Clerical | 2,462 | 5.902 | 1,746 | 5.958 | 1,447 | 5.389 |
| Sales Workers | 564 | 1.352 | 383 | 1.307 | 304 | 1.132 |
| Craftsmen, Foremen | 3,257 | 7.808 | 2,251 | 7.682 | 2,258 | 8.410 |
| Operators | 1,575 | 3.776 | 1,252 | 4.273 | 1,289 | 4.801 |
| Private Household Workers | 395 | 0.947 | 226 | 0.770 | 154 | 0.574 |
| Service | 1,480 | 3.548 | 1,116 | 3.808 | 906 | 3.374 |
| Farm Labourers | 61 | 0.146 | 40 | 0.137 | 39 | 0.145 |
| Labourers (except farms and mines) | 1,066 | 2.555 | 903 | 3.082 | 840 | 3.129 |
| Dependents | 22,539 | 54.030 | 15,836 | 54.042 | 14,346 | 53.432 |

TABLE I-16

Estimated[a] Ontario Emigrants to the United States by Major Occupational Groups, 1962-1970

| Occupation | 1962 | | 1963 | | 1964 | |
|---|---|---|---|---|---|---|
| | Number | %[b] | Number | % | Number | % |
| Total Estimated Ontario Emigrants[c] | 20,335 | 100 | 21,542 | 100 | 22,603 | 100 |
| Professional & Technical | 2,554 | 12.561 | 2,729 | 12.667 | 2,879 | 12.736 |
| Farmers & Farm Managers | 55 | 0.269 | 51 | 0.238 | 52 | 0.229 |
| Managerial | 493 | 2.426 | 505 | 2.346 | 595 | 2.631 |
| Clerical | 2,018 | 9.925 | 2,102 | 9.757 | 2,353 | 10.412 |
| Sales Workers | 577 | 2.837 | 576 | 2.673 | 601 | 2.657 |
| Craftsmen, Foremen | 1,761 | 8.658 | 1,785 | 8.284 | 1,840 | 8.141 |
| Operators | 956 | 4.700 | 1,060 | 4.922 | 1,038 | 4.592 |
| Private Household Workers | 156 | 0.766 | 174 | 0.810 | 171 | 0.755 |
| Service | 907 | 4.459 | 893 | 4.144 | 977 | 4.324 |
| Farm Labourers | 91 | 0.447 | 82 | 0.380 | 70 | 0.309 |
| Labourers (except farms and mines) | 949 | 4.669 | 920 | 4.271 | 838 | 3.709 |
| Non-workers | 9,818 | 48.283 | 10,665 | 49.510 | 11,190 | 49.505 |

a. These figures are estimated by applying the percentages calculated from Table I-15 for different occupational groups to the total estimated Ontario emigrants.

b. The percentages of different occupational groups for 1962-70 are taken from the percentage columns of every year in Table I-15.

c. The figures for the total estimated Ontario emigrants are taken from Column (5) of Table I-14 for 1962-70.

TABLE I-16 (Continued)

| Occupation | 1965 | | 1966 | | 1967 | |
|---|---|---|---|---|---|---|
| | Number | %[b] | Number | % | Number | % |
| Total Estimated Ontario Emigrants[c] | 22,215 | 100 | 17,559 | 100 | 17,321 | 100 |
| Professional & Technical | 2,921 | 13.149 | 2,632 | 14.989 | 2,972 | |
| Farmers & Farm Managers | 65 | 0.294 | 40 | 0.228 | 20 | 17.157 |
| Managerial | 562 | 2.528 | 481 | 2.737 | 473 | 0.118 |
| Clerical | 2,309 | 10.393 | 1,493 | 8.505 | 786 | 2.730 |
| Sales Workers | 546 | 2.460 | 363 | 2.069 | 236 | 4.539 |
| Craftsmen, Foremen | 1,793 | 8.072 | 1,157 | 6.587 | 1,244 | 1.360 |
| Operators | 948 | 4.267 | 659 | 3.753 | 588 | 7.182 |
| Private Household Workers | 154 | 0.692 | 103 | 0.585 | 135 | 3.397 |
| Service | 894 | 4.025 | 582 | 3.313 | 568 | 0.779 |
| Farm Labourers | 61 | 0.274 | 36 | 0.207 | 20 | 3.279 |
| Labourers (except farms | 955 | 4.301 | 591 | 3.367 | 363 | 0.118 |
| and mines) | | | | | | 2.097 |
| Non-workers | 11,006 | 49.545 | 9,422 | 53.661 | 9,915 | 57.245 |

TABLE I-16 (Continued)

| Occupation | 1968 | | 1969 | | 1970 | |
|---|---|---|---|---|---|---|
| | Number | %[b] | Number | % | Number | % |
| Total Estimated Ontario Emigrants[c] | 20,145 | 100 | 14,194 | 100 | 12,222 | 100 |
| Professional & Technical | 3,437 | 17.061 | 2,335 | 16.452 | 2,082 | 17.032 |
| Farmers & Farm Managers | 18 | 0.089 | 14 | 0.102 | 16 | 0.127 |
| Managerial | 562 | 2.788 | 339 | 2.385 | 300 | 2.454 |
| Clerical | 1,189 | 5.902 | 846 | 5.958 | 659 | 5.389 |
| Sales Workers | 272 | 1.352 | 186 | 1.307 | 138 | 1.132 |
| Craftsmen, Foremen | 1,573 | 7.808 | 1,090 | 7.682 | 1,028 | 8.410 |
| Operators | 761 | 3.776 | 607 | 4.273 | 587 | 4.801 |
| Private Household Workers | 191 | 0.947 | 109 | 0.771 | 70 | 0.574 |
| Service | 715 | 3.548 | 541 | 3.808 | 412 | 3.374 |
| Farm Labourers | 29 | 0.146 | 19 | 0.137 | 18 | 0.145 |
| Labourers (except farms and mines) | 515 | 2.555 | 437 | 3.082 | 382 | 3.129 |
| Non-workers | 10,884 | 54.030 | 7,671 | 54.042 | 6,530 | 53.432 |

measured in terms of the value added. However, for the industries in the other sector there is no such index of output. Consequently, the manpower requirements for the other sector were projected using the occupational distribution method.

The steps involved in obtaining the required manpower inflows for each year to 1990 are presented in Figure I-1. Briefly, the task of obtaining required manpower inflows involved the following:

1) Projection of the gross manpower requirements for the goods-producing sector, using the occupational co-efficient method;
2) Projection of the gross manpower requirements for the other sector, using the occupational distribution method;
3) Summation of the results of (1) and (2) to obtain gross manpower requirements for the whole economy;
4) Projection of attrition, and addition of that attrition to the projected growth in manpower requirements to obtain projections of required manpower inflows.

An overview of the method used, the underlying assumptions, sources of data, and the adjustments made in the data is presented below.

2. <u>Projection of the gross manpower requirements for the goods-producing sector</u>

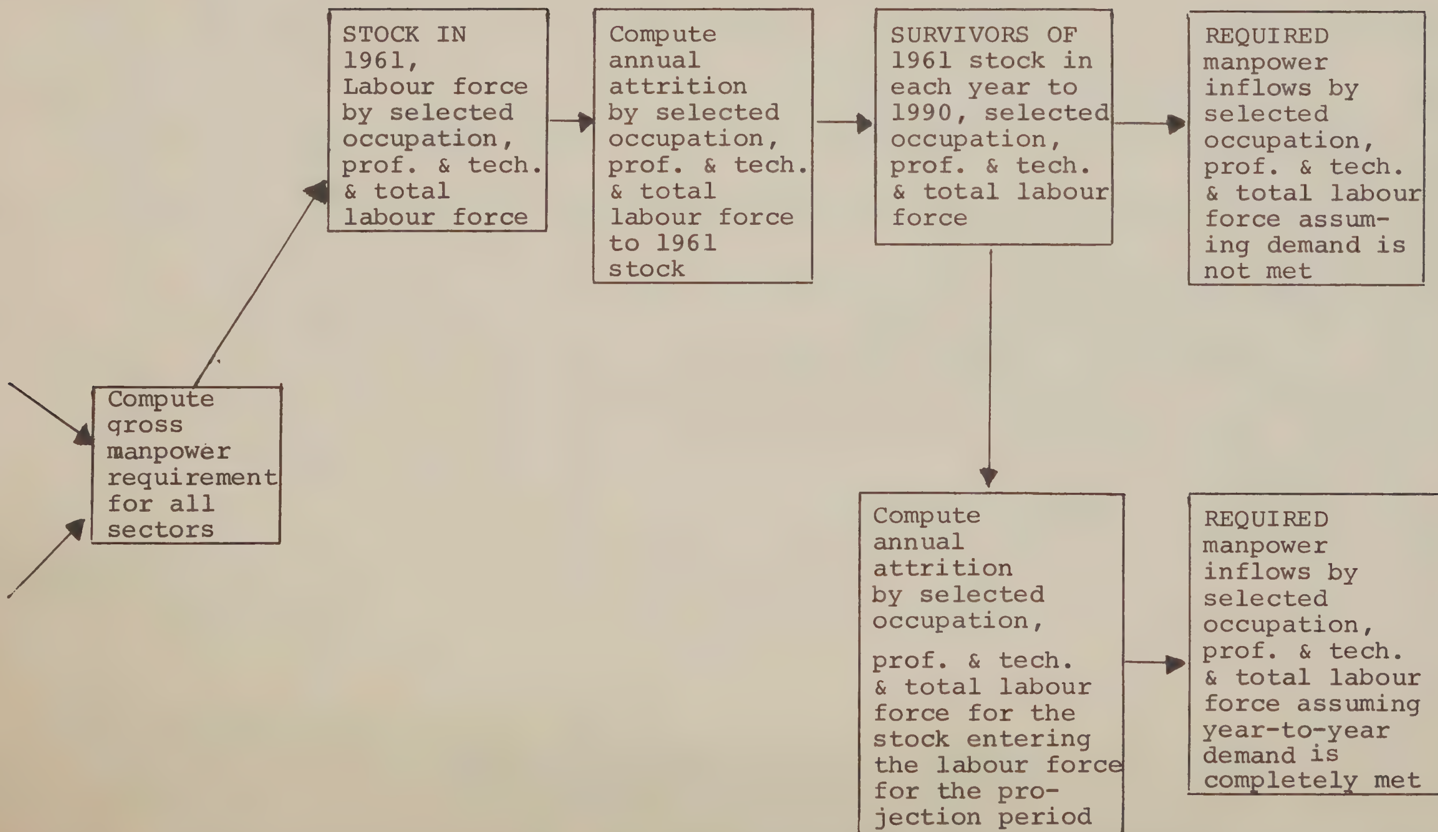
The occupational co-efficient method for projecting the

FIGURE I-1

Methodology Used in Projecting Manpower Requirements

| SECTOR | SUB-SECTOR NO. | SUB-SECTOR INDUSTRIES | Method Used for Manpower Projections | STEPS |
|---|---|---|---|---|
| GOODS PRO-DUCING SECTOR | 1-32 | Manufacturing | OCCUPATIONAL CO-EFFICIENTS | Project output for each year to 1990 by sub-sector<br>Estimate and project occupational co-efficients by selected occupations (prof. & tech.) & total labour force by sub-sector<br>Gross manpower require-ments by selected occupation, and total labour force by sub-sector<br>Compute gross manpower require-ments by selected occupa-tion, total prof. & tech. & total labour force for Goods-producing Sector |
| | 33 | Agriculture | | |
| | 34 | Forestry | | |
| | 35 | Fishing & Trapping | | |
| | 36 | Mines, Quarries & Oil Wells | | |
| | 37 | Construction | | |
| OTHER SECTOR | 38 | Transportation, Communication and Other Utilities | EMPLOYMENT & OCCUPATIONAL DISTRIBUTION | Project total labour force by sub-sector using employ-ment & census data<br>Project total prof. & tech. labour force on a % of total labour force by sub-sector<br>Project labour force by selected occupation, by sub-sector<br>Compute gross manpower requirements by selected occupation, total prof. & tech. & total labour force for "other sector" |
| | 39 | Trade | | |
| | 40 | Finance, Insurance and Real Estate | | |
| | 41 | Services, Non-commercial | | |
| | 42 | Services, Commercial | | |
| | 43 | Public Administration (Exclusive Defence) | | |

FIGURE I-1 (Continued)



manpower requirements can be described by the following relationship

$$G^t = C^t \cdot X^t$$

where

$G^t$ is the (m x 1) vector of gross manpower requirements by occupation in year t

$C^t$ is the (m x n) order matrix of occupational co-efficients by industry. Each element represents the number of persons in a given occupation in a particular sub-sector per million dollars of output in constant dollars in year t

$X^t$ is the (n x 1) vector representing output by sub-sector in year t.

In order to project manpower requirements by this method, it is necessary to project the output by sub-sector, and the occupational co-efficients for each occupation in each sub-sector. The methods used for projecting these components are described below.

a. projection of output for the manufacturing sector: The basic data for each of the 32 manufacturing sub-sectors was the Census of Manufactures. The data consisted of a time series for 1957 to 1967 of the value-added in manufacturing activity.[1] The output data for each sub-sector was converted

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[1]There was also a time series of value-added in total activity for 1961 to 1967.

into annual growth rates and several different regressions were tried in order to obtain an adequate equation for predicting the growth rates. Letting $g_i^t$ refer to the growth rate in year t for sub-sector i, the regressions tried were of the following forms:

i) $g_i^t = a_i + b_i g_i^{t-1}$

ii) $g_i^t = a_i + b_i g_i^{t-1} + c_i g_i^{t-2}$

iii) $g_i^t = a_i + b_i g_i^{t-1} + c_i g_i^{t-2} + d_i g_i^{t-3}$

iv) $g_i^t = b_i g_i^{t-1} + c_i g_i^{t-2} + d_i g_i^{t-3}$

It was found that for short-range projections these regressions gave good predictions for some but not for all sub-sectors. For longer-range projections, better results were obtained with equation (v) which assumes a constant growth rate:

v) $\log o_i^t = a_i + b_i t$, or equivalently

vi) $g_i^t = b_i$

where $o_i^t$ is the actual value-added in manufacturing activity in year t for sub-sector i. The more complicated formulae introduce the year-by-year variations that are necessary for short-term projections. However, these variations are not helpful in making long-term projections.

A problem arises with projecting independently the growth rate for each sub-sector. The weighted sum of predicted sub-

sector growth rates may not be consistent with the best predictor of the overall growth rate. It was decided that the overall growth rate would, in general, be closer to its predicted value in any given year than most of the specific growth rates for each of the sub-sectors. It was assumed that the predictions for the sum of all sub-sectors would be more accurate than the sum of the predictions for individual sub-sectors. Separate projections were made for the overall growth rate, and the growth rates for each of the sub-sectors were modified to conform to the predicted overall growth rate.[2]

The best constant predictor for the overall growth rate, based on 1957-67 data for the value-added in manufacturing activity, was 5.45% with a variance of 2.21%. Three projections were made, assuming that the overall growth rates were between one and a half standard deviations above and below 5.45%. However, after examining the results of these projections and noting that the real growth rate in manufacturing has declined considerably since 1967, it was

---

[2]The procedures for systematically modifying projections for individual sub-sectors to conform to the projections for the overall growth rate are somewhat complicated statistically, and they were not thought to be of interest to the general reader. Further information can be obtained by contacting the authors.

decided to assume that the overall growth rates would be 3.5, 4.0, and 4.5 for the low, medium, and high projections. Although this might seem arbitrary, it was felt that these projections would be more realistic than any which did not take account of the slowdown of the economy in recent years. In addition, several of the projections for specific sub-sectors derived from the standard projection equation were thought to be unrealistic. These were modified on the basis of qualitative information about trends in these sub-sectors.[3]

The results of the projections of constant dollar output by sub-sector are given in Table I-17.[4] There are three sets of projections for each sub-sector, estimates 1, 2 and 3, corresponding to the three different overall growth rates assumed for the manufacturing sector, 3.5%, 4.0% and 4.5% respectively. The data for 1961 through 1967 are actual figures in 1961 dollars.

b. projection of output for the rest of the goods-producing sector: The agricultural sector's output was projected

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[3]More details about specific adjustments can be obtained from the authors.

[4]Tables I-17, I-18, I-19, I-20, I-21, and I-23 contain the results of intermediate projections upon which the actual manpower requirements projections are based. They consist of 91 pages of figures and have been omitted from this version of the report. They are available in the library of The Ontario Institute for Studies in Education and are on file in the archives of the Commission on Post-secondary Education in Ontario.

separately from that of the manufacturing sector. The basic data is taken from the DBS Survey of Production and consisted of the census value-added figures for 1957 to 1967. Because of a change in definition (Survey of Production, 1968: 9) in the agricultural sector, there were two time series. The 1957-61 time series was based on the old definition, and the 1961-67 time series used the new definition. To splice the two series together, each figure for the 1957-60 time series was multiplied by the ratio of the 1961 figure using the new definition to the 1961 figure using the old definition. The data were then converted into constant 1961 dollars. The basic data for the forestry, fishing and trapping, mining, and construction sectors consisted of census value-added figures for 1957-67 which were transformed into constant (1961) dollars. The results of the projections of output for these sub-sectors are given in Table I-18 (see footnote 4).

Before leaving the output projections, a few warnings should be given. Projecting aggregate or sectoral output over such a large time span is hazardous. No nation can expect many years to pass during which its industrial development will continue free of such disruptive occurrences as recession and war; if not its own, then somebody else's. Much less can a jurisdiction like Ontario, with so much of its economic fortunes determined outside its borders and beyond the influence of its own and Canada's policy-makers, expect many

years to pass without some disruptive occurrence upsetting smooth trends in its industrial development.

The 1957-67 trends have been scaled down to take account of the much slower growth of the Canadian economy during the last few years. In addition to the effect of recessions, the ecological constraints which are the subject of increasing concern may begin to have a greater impact by 1990. There is some concern that the growth rates of the first two post war decades may not be sustainable indefinitely. The signs of serious resource depletion may show up during the 1970-90 period, and these may lead to policies of intentional moderation of the rate of economic growth. Such a major change in economic policy was not taken into consideration in the output projections in this study.

c. estimation and projection of occupational co-efficients: The occupational co-efficient for occupation i in sub-sector j indicates the "number of persons required in that occupation to produce a unit of output in the j-th sector." In general, the occupational co-efficients depict the state of the technology in the production sector.

In order to analyze the trends in the occupational co-efficients over time, one must have commensurate data for each industry on output and on employment by occupation. For Ontario, the only source of data on occupation by industry is the decennial census. Because of changes in classifica-

tion it was possible to estimate occupational co-efficients by industry for only 1951 and 1961. The estimation of the occupational co-efficients for 1951 and 1961 involved the following steps:

(1) collection of data on labour force[5] by industry and occupation for 1951 and 1961;

(2) reclassification of 1951 industry-occupation data on the basis of the 1961 classification system;

(3) grouping the reclassified data into the sub-sectors defined in Table I-2;

(4) collection of data on output by industry for 1951 and 1961;

(5) grouping the output data by sub-sector;

(6) conversion of output into constant dollars (1961=100);

(7) dividing occupational inputs (3) by corresponding outputs (6) for each sub-sector to obtain occupational co-efficients.

The change in the census definitions between 1951 and 1961 caused some problems. In the case of industries, even at the lowest level of disaggregation, many individual industries were non-comparable between the two years. However, comparability could be attained by relating a group of industries

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[5] Ideally, one should use data on employment rather than labour force for calculating occupational co-efficients. However, the census provides information only on labour force. The resulting projections are in terms of labour force requirements, and are not adjusted for unemployment.

from the 1951 census to a group from the 1961 census. In some cases, the group included only part of a three-digit industry. Adjustments involving the inclusion or exclusion of a part of a three-digit industry were ignored because of the lack of information on the occupational distribution for the part of the industry involved. However, generally the magnitude of such an adjustment would have been small, and it is unlikely that much bias was introduced by this procedure.

For occupations, the problems of comparability were more serious than for industries. Some occupations were listed in one census year but not in another, e.g. physicists and geologists which appeared only in 1961. Other occupations appeared with the same title in both 1951 and 1961, but the definitions differed considerably between the two years, e.g. social welfare workers. Such occupations were not comparable between censuses, and no adjustments could have established comparability. For these occupations, the 1951 occupational co-efficient was calculated on the basis of the 1951 occupational definition, and the 1961 co-efficient on the basis of the 1961 definition.

In making projections of the occupational co-efficients, a different method was used for occupations which were comparable between census years than for the non-comparable occupations. For non-comparable occupations, the occupational co-efficient was assumed to be constant over time and equal

to the 1961 co-efficient. This assumption was made out of ignorance about long-term trends in occupational co-efficients.

This assumption is made often in cases where historical data on occupational co-efficients are lacking. However, Blaug has pointed out that the assumption can be quite unreliable. In Britain, the Zuckerman Committee in 1956 made a ten-year projection of scientists and engineers assuming fixed occupational co-efficients. The actual occupational co-efficients rose sharply over the next three years, making it appear that the manpower projections would be underestimates[6] (Blaug, 1970: 148). Yet little is known in general about historical trends in occupational co-efficients. Of the nine occupations in Ontario which are comparable between 1951 and 1961, the co-efficients for males in manufacturing went up in three, down in three, and were constant in three.

For the comparable occupations, simple non-linear projection equations were developed. The object of these equations was to dampen the rate of increase or of decrease in the value of the occupational co-efficients. The projection equations are given in terms of the following notation:

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[6]Much of the increase in the observed occupational co-efficients was probably due to supply effects.

F--represents the (m x n) matrix of occupational co-efficients by sub-sector in 1951, assuming there are m occupations and n sub-sectors

S--represents the (m x n) matrix of occupational co-efficients for comparable occupations in 1961

P--represents the (m x n) matrix of projected occupational co-efficients for comparable occupations in 1971.

Let $f_{ij}$, $s_{ij}$, and $p_{ij}$ be typical elements of the matrices F, S and P, respectively. Then if $f_{ij} > s_{ij}$, define $y_{ij}$ as:

$$y_{ij} = \frac{s_{ij}}{f_{ij}}$$

In these cases, the projection of the occupational co-efficient for the i-th occupation and j-th sector was made according to the equation

$$p_{ij} = y_{ij} \cdot s_{ij}$$

If $f_{ij} < s_{ij}$

define $x_{ij} = \dfrac{f_{ij}}{s_{ij}}$

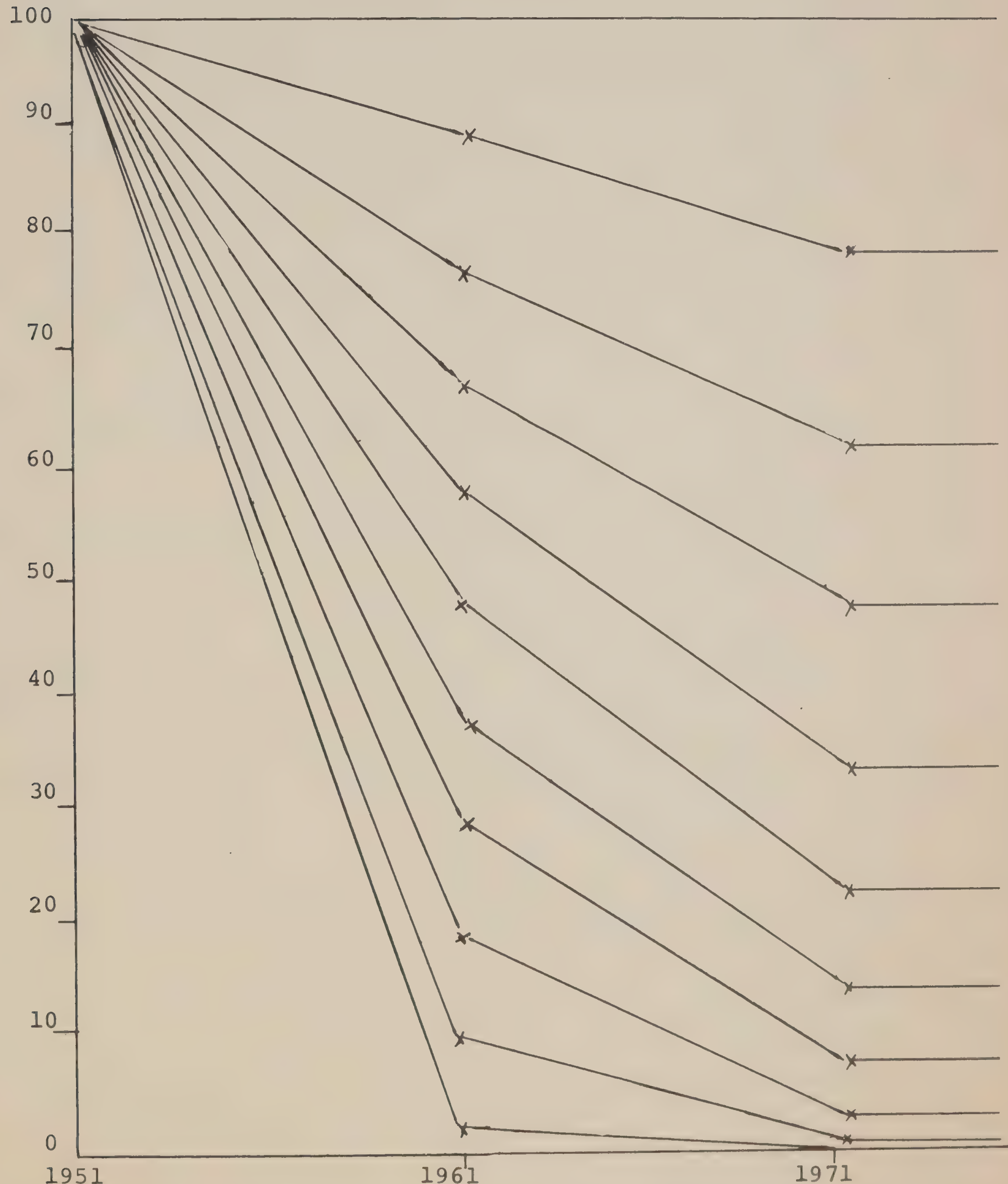
In this case the projection was made by the equation

$$p_{ij} = s_{ij} + \left(\frac{1 - x_{ij}}{2}\right) \cdot \left(\frac{f_{ij} + s_{ij}}{2}\right)$$

The graphic implications of the above projection equations are shown in Figure I-2. The figure consists of a family

FIGURE I-2

Illustration of the Method for Projecting Occupational Co-efficient when the 1961 Co-efficient is Less Than the 1951 Co-efficient



of trend lines. The first segment of a trend line shows the decrease in an occupational co-efficient between 1951 and 1961. The second segment indicates the decrease projected between 1961 and 1971. It was assumed further that the co-efficients would remain constant after 1971. An analogous family of trend lines could be drawn for cases when the 1961 co-efficient exceeds the 1951 co-efficient.

Table I-19[7] shows the results of the projections of occupational co-efficients for the comparable occupations by sex and sub-sector in the goods-producing sector. The gross manpower requirements for the goods-producing sector were then obtained by multiplying projected output by the projected occupational co-efficient for each sub-sector and summing over all sub-sectors. Further explanation of the results will be given after a brief discussion of the projection of gross manpower requirements for the other sector.

3. <u>Projection of the gross manpower requirements for the other sector using the occupational distribution method</u>

The projection of manpower requirements for the other sector consisted of the following steps:

(1) projection of the labour force by sub-sector;

(2) projection of the professional and technical group as a

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[7]See footnote 4.

proportion of the total labour force of each sub-sector;

(3) projection of the size of the professional and technical component of the labour force by sub-sector; obtained through multiplication of (1) by (2);

(4) projection of the percentage distribution of the professional and technical group by occupation class for each sub-sector;

(5) projection of the size of each occupation class in highly qualified manpower by sub-sector, obtained by multiplying (4) by (3).

There were two alternatives for projecting the total labour force by sub-sector. First, one could use annual data on employment by industry from the DBS _Estimates of Employees by Province and Industry_ (Cat. No. 72-508). The relative growth in these series for each industry could be projected directly and a series of indices constructed for employment in the projection period relative to employment in 1961 (letting employment in 1961 = 100). These indices could then be applied to the figures on labour force by industry from the 1961 census to obtain projections of the labour force by industry.

Alternatively one could project the percentage distribution of the labour force by industry from the Employment Survey data; project the total labour force from population and labour force survey data; and apply the projected percentage distri-

bution by industry to the projected total labour force.

Both methods were tried. However, the first method was found to be preferable for two reasons. First, the Employment Survey is generally a more reliable source of data for individual sectors than it is for the aggregate of all economic activity. Some sectors have not been covered by the employment survey--notably defense and public services. The second method would be sensitive to errors and fluctuations in the sectors which one was not interested in projecting as well as those in which one was interested. Next, the second method unlike the first would introduce errors from the Labour Force Survey into the projection. Taking these factors in account, we have presented results only on the basis of the first method.[8]

Data on the professional and technical group as a proportion of the labour force by sub-sector are available only from the decennial census, and the percentages could be calculated for only 1951 and 1961. The trends were projected by linear extrapolation. The results are shown in Table I-20,[9] which gives the actual percentages for 1951 and 1961 and the projections for selected years for each of the sub-sectors.

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[8]For the sake of brevity, the projections of labour force by sub-sector have not been included in this report. These data may be obtained from the authors.

[9]See footnote 4.

Projections of the professional and technical group by sub-sector were obtained from the projections of total labour force and projections of the professional and technical group as a proportion of the labour force. Next to be projected were the numbers in each of selected occupational classes as a proportion of the professional and technical group by sub-sector. These projections were made by assuming the proportions to be constant at the 1961 values. From projections of these proportions and projections of the total for professional and technical by sub-sector, projections for specific occupational classes were made.

The projections of gross manpower requirements for the whole economy, excluding defense and "industries, unspecified", are presented in Table I-21.[10] The underlying assumptions for each set of projections are presented as Figure I-3. There are twelve sets of projections. These correspond to three different assumptions about the rate of growth of output in manufacturing, two different assumptions about trends in occupational co-efficients in the goods-producing sector, and two different assumptions about the relationship between the sub-sector projections and the aggregate projections for manufacturing. In one case trend projections of occupational co-efficients were made for comparable occupations, and in the other case these co-efficients were assumed constant at the 1961

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[10]See footnote 4.

FIGURE I-3

Assumptions Underlying the Different Sets of Projections of Gross Manpower Requirements Presented as Table I-21[a]

| ASSUMPTIONS | | | Projection Number | Page No. of Table I-21 |
|---|---|---|---|---|
| Occupational Co-efficients | Output | | | |
| 1961 Occupational Co-efficients Assumed Constant | Output Estimate 1 (Low) | Manufacturing Projected by Sub-Sector | 1 | 1-3 |
| | | Manufacturing Projected as One Industry | 2 | 4-6 |
| | Output Estimate 2 (Medium) | Manufacturing Projected by Sub-Sector | 3 | 7-9 |
| | | Manufacturing Projected as One Industry | 4 | 10-12 |
| | Output Estimate 3 (High) | Manufacturing Projected by Sub-Sector | 5 | 13-15 |
| | | Manufacturing Projected as One Industry | 6 | 16-19 |
| Projected Occupational Co-efficients for each year between 1961-1971, and then Assumed Constant at 1971 Level | Output Estimate 1 (Low) | Manufacturing Projected by Sub-Sector | 7 | 19-21 |
| | | Manufacturing Projected as One Industry | 8 | 22-24 |
| | Output Estimate 2 (Medium) | Manufacturing Projected by Sub-Sector | 9 | 25-27 |
| | | Manufacturing Projected as One Industry | 10 | 28-31 |
| | Output Estimate 3 (High) | Manufacturing Projected by Sub-Sector | 11 | 31-33 |
| | | Manufacturing Projected as One Industry | 12 | 34-36 |

[a]Table I-21 is not included in this edition of the report. See footnote 4.

level. Under one set of assumptions, projections for the manufacturing sector were made from aggregate data; under the other set, projections were obtained by summing the projections for the individual sub-sectors.

D. <u>Projection of Required Manpower Inflows</u>

The required manpower inflow during any year t is defined as the gross manpower requirement for year t less the manpower stock at the beginning of year t-1 plus attrition of the manpower stock during year t-1.

In most studies only attrition of the manpower stock that exists at the beginning of the projection period is considered, and not attrition of those who enter the labour force during the projection period (e.g. Ahamad, 1970). For a short projection period, this omission is not serious. There will be relatively few new entrants to the labour force, and they will be young, say under 30, by the end of the projection period. For a long projection period, attrition of new entrants should not be ignored. In order to calculate attrition of those who enter the labour force in each occupation during the projection period, one must make some assumption about the numbers who will enter. The most optimistic assumption is that the number of new entrants during year t is exactly the number which will make the supply in year t equal to the gross manpower requirements for year t. That is, the number of new entrants in year t is assumed equal to the

gross manpower requirement for year t less the stock at the end of year t-1. One could assume alternatively that the gross requirements for any year were not fulfilled or were more than fulfilled.

Rather than pursue all of the possible assumptions, two sets of estimates of attrition were derived. The first set was based on the extreme assumption that the actual number of new entrants during any intermediate year of the projection period is zero. In this case, the only attrition during the projection period is on the 1961 labour stock. The required inflow for any year t is then the gross manpower requirements for year t less the number from the 1961 stock who survive to year t.[11] The calculations of the projected required manpower inflows made under this assumption are those designated "Year to Year Requirements Met: Zero" in Table I-22.

The other set of estimates of attrition was made under the optimistic assumption that the actual number of new entrants during any year t is that which will make the supply equal to gross manpower requirements in year t, i.e. the actual inflow during year t is assumed equal to the gross manpower requirements for year t less the stock at the end of year t-1. In estimating the stock at the end of year t-1, attrition is calculated for those who are assumed to have entered the labour

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[11]The number of survivors of the 1961 stock in each occupation are shown in Table I-23, omitted from this version of the report (see footnote 4 above).

# PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 211. | 638. | 383. | 2. | 123. | 206. | 202. | 3. |
| 1963 | 330. | 722. | 412. | 7. | 62. | 242. | 158. | 13. |
| 1964 | 353. | 804. | 457. | 42. | 141. | 298. | 259. | 41. |
| 1965 | 383. | 807. | 492. | 67. | 190. | 323. | 226. | 61. |
| 1966 | 494. | 855. | 472. | 11. | 134. | 271. | 209. | 12. |
| 1967 | 306. | 305. | 188. | 115. | 50. | 110. | 156. | 105. |
| 1968 | 345. | 466. | 336. | 54. | 110. | 204. | 204. | 52. |
| 1969 | 353. | 485. | 348. | 55. | 115. | 210. | 212. | 54. |
| 1970 | 362. | 502. | 359. | 57. | 119. | 218. | 219. | 56. |
| 1971 | 373. | 523. | 372. | 57. | 126. | 224. | 227. | 57. |
| 1972 | 382. | 541. | 385. | 59. | 131. | 231. | 235. | 58. |
| 1973 | 393. | 562. | 398. | 59. | 135. | 240. | 244. | 60. |
| 1974 | 403. | 583. | 411. | 61. | 142. | 247. | 252. | 63. |
| 1975 | 413. | 603. | 424. | 62. | 147. | 255. | 261. | 64. |
| 1976 | 425. | 623. | 439. | 63. | 154. | 263. | 269. | 66. |
| 1977 | 436. | 644. | 451. | 64. | 160. | 270. | 279. | 67. |
| 1978 | 447. | 663. | 464. | 64. | 165. | 278. | 286. | 69. |
| 1979 | 458. | 683. | 477. | 66. | 172. | 284. | 296. | 72. |
| 1980 | 468. | 704. | 491. | 66. | 177. | 293. | 304. | 73. |
| 1981 | 423. | 709. | 490. | 63. | 176. | 287. | 288. | 66. |
| 1982 | 431. | 728. | 502. | 64. | 181. | 292. | 295. | 66. |
| 1983 | 438. | 747. | 513. | 55. | 188. | 300. | 302. | 68. |
| 1984 | 445. | 764. | 524. | 64. | 193. | 305. | 310. | 69. |
| 1985 | 452. | 782. | 536. | 65. | 198. | 312. | 317. | 70. |
| 1986 | 457. | 800. | 545. | 67. | 203. | 318. | 325. | 71. |
| 1987 | 453. | 817. | 556. | 67. | 209. | 322. | 331. | 72. |
| 1988 | 468. | 835. | 565. | 67. | 213. | 329. | 338. | 73. |
| 1989 | 473. | 854. | 577. | 68. | 220. | 335. | 345. | 74. |
| 1990 | 477. | 873. | 587. | 69. | 224. | 341. | 352. | 74. |

Table I-22

(Page 1 of 72)
Projection 1-A

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT
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| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI- NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 35. | 50. | 50. | 1002. | 21. |
| 1963 | 30. | 26. | 49. | -9. | 47. | 698. | 100. |
| 1964 | 32. | 30. | 47. | 7. | 54. | 693. | 101. |
| 1965 | 33. | 33. | 33. | 57. | 59. | 691. | 104. |
| 1966 | 35. | 29. | 55. | 109. | 73. | 682. | 109. |
| 1967 | 29. | 38. | 41. | -38. | 45. | 680. | 101. |
| 1968 | 33. | 35. | 50. | 29. | 59. | 673. | 104. |
| 1969 | 34. | 36. | 51. | 31. | 62. | 670. | 105. |
| 1970 | 35 | 38. | 53. | 31. | 63. | 664. | 106. |
| 1971 | 36. | 38. | 54. | 34. | 64. | 661. | 106. |
| 1972 | 38. | 40. | 55. | 35. | 66. | 657. | 107. |
| 1973 | 38. | 41. | 57. | 36. | 68. | 653. | 109. |
| 1974 | 41. | 42. | 59. | 39. | 68. | 650. | 111. |
| 1975 | 42. | 44. | 59. | 39. | 71. | 645. | 111. |
| 1976 | 43. | 45. | 62. | 41. | 72. | 641. | 113. |
| 1977 | 44. | 47. | 62. | 42. | 73. | 636. | 113. |
| 1978 | 45. | 47. | 64. | 43. | 75. | 631. | 115. |
| 1979 | 46. | 48. | 65. | 44. | 77. | 624. | 117. |
| 1980 | 48. | 50. | 67. | 44. | 78. | 617. | 117. |
| 1981 | 35. | 35. | 51. | 40. | 58. | 596. | 112. |
| 1982 | 36. | 36. | 52. | 40. | 60. | 587. | 113. |
| 1983 | 37. | 37. | 52. | 41. | 61. | 577. | 113. |
| 1984 | 37. | 36. | 53. | 41. | 60. | 566. | 114. |
| 1985 | 37. | 37. | 52. | 41. | 61. | 555. | 113. |
| 1986 | 38. | 37. | 53. | 41. | 61. | 544. | 114. |
| 1987 | 37. | 37. | 53. | 41. | 61. | 531. | 113. |
| 1988 | 38. | 37. | 54. | 41. | 62. | 519. | 114. |
| 1989 | 38. | 38. | 53. | 40. | 62. | 506. | 113. |
| 1990 | 38. | 37. | 53. | 41. | 62. | 493. | 113. |

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

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| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 117. | 80. | 33. | 374. | 948. | 22175. | 162389. |
| 1963 | 153. | 109. | 44. | 369. | 1212. | 19533. | 161060. |
| 1964 | 146. | 102. | 38. | 372. | 1287. | 20878. | 177106. |
| 1965 | 173. | 120. | 49. | 373. | 1234. | 21099. | 215283. |
| 1966 | 138. | 97. | 34. | 377. | 1502. | 21317. | 239214. |
| 1967 | 99. | 84. | 29. | 377. | 821. | 17300. | 118125. |
| 1968 | 117. | 92. | 34. | 382. | 1069. | 18979. | 159095. |
| 1969 | 120. | 96. | 33. | 383. | 1097. | 19126. | 164189. |
| 1970 | 124. | 98. | 35. | 386. | 1125. | 19268. | 167925. |
| 1971 | 127. | 102. | 36. | 388. | 1154. | 19409. | 164462. |
| 1972 | 131. | 104. | 37. | 389. | 1183. | 19548. | 171138. |
| 1973 | 134. | 107. | 38. | 391. | 1212. | 19685. | 175008. |
| 1974 | 138. | 110. | 40. | 393. | 1241. | 19823. | 177347. |
| 1975 | 142. | 113. | 41. | 392. | 1268. | 19959. | 180752. |
| 1976 | 146. | 116. | 42. | 394. | 1298. | 20095. | 183170. |
| 1977 | 149. | 119. | 44. | 395. | 1325. | 20231. | 186127. |
| 1978 | 153. | 123. | 46. | 395. | 1352. | 20368. | 189008. |
| 1979 | 155. | 125. | 47. | 395. | 1379. | 20503. | 191907. |
| 1980 | 159. | 129. | 48. | 396. | 1407. | 20642. | 194816. |
| 1981 | 147. | 117. | 46. | 331. | 1317. | 19841. | 197099. |
| 1982 | 149. | 118. | 48. | 328. | 1338. | 19932. | 200137. |
| 1983 | 152. | 120. | 49. | 325. | 1357. | 20020. | 203275. |
| 1984 | 154. | 123. | 51. | 322. | 1378. | 20106. | 206358. |
| 1985 | 156. | 125. | 51. | 318. | 1398. | 20188. | 209534. |
| 1986 | 159. | 125. | 53. | 316. | 1416. | 20269. | 212858. |
| 1987 | 161. | 129. | 55. | 313. | 1437. | 20346. | 216064. |
| 1988 | 163. | 130. | 55. | 310. | 1457. | 20426. | 219333. |
| 1989 | 164. | 131. | 56. | 306. | 1476. | 20504. | 222721. |
| 1990 | 168. | 134. | 58. | 304. | 1497. | 20579. | 226141. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 208. | 545. | 339. | 5. | 138. | 188. | 228. | 4. |
| 1963 | 332. | 552. | 351. | 12. | 132. | 218. | 226. | 14. |
| 1964 | 344. | 667. | 400. | 44. | 164. | 256. | 278. | 42. |
| 1965 | 392. | 724. | 426. | 68. | 177. | 278. | 302. | 61. |
| 1966 | 480. | 589. | 377. | 13. | 136. | 233. | 231. | 13. |
| 1967 | 322. | 297. | 244. | 113. | 61. | 154. | 154. | 105. |
| 1968 | 348. | 459. | 324. | 55. | 107. | 199. | 203. | 51. |
| 1969 | 355. | 476. | 335. | 56. | 111. | 206. | 211. | 55. |
| 1970 | 365. | 495. | 346. | 58. | 116. | 213. | 219. | 56. |
| 1971 | 375. | 514. | 359. | 58. | 120. | 219. | 226. | 57. |
| 1972 | 386. | 533. | 370. | 60. | 127. | 227. | 235. | 58. |
| 1973 | 395. | 552. | 383. | 61. | 131. | 233. | 242. | 61. |
| 1974 | 407. | 573. | 395. | 62. | 136. | 242. | 251. | 62. |
| 1975 | 417. | 593. | 409. | 63. | 143. | 248. | 259. | 65. |
| 1976 | 428. | 612. | 421. | 64. | 148. | 257. | 268. | 66. |
| 1977 | 439. | 632. | 433. | 65. | 155. | 263. | 277. | 67. |
| 1978 | 451. | 652. | 446. | 66. | 159. | 272. | 284. | 69. |
| 1979 | 462. | 671. | 459. | 67. | 166. | 278. | 294. | 72. |
| 1980 | 472. | 691. | 470. | 68. | 171. | 285. | 302. | 73. |
| 1981 | 429. | 696. | 471. | 65. | 170. | 279. | 286. | 66. |
| 1982 | 435. | 714. | 481. | 65. | 175. | 285. | 293. | 66. |
| 1983 | 443. | 731. | 491. | 67. | 180. | 291. | 301. | 69. |
| 1984 | 450. | 750. | 501. | 67. | 186. | 297. | 307. | 69. |
| 1985 | 457. | 765. | 512. | 67. | 190. | 302. | 314. | 70. |
| 1986 | 462. | 783. | 521. | 68. | 195. | 308. | 321. | 71. |
| 1987 | 469. | 800. | 530. | 70. | 201. | 314. | 327. | 72. |
| 1988 | 474. | 817. | 540. | 70. | 206. | 320. | 335. | 73. |
| 1989 | 480. | 834. | 549. | 70. | 210. | 325. | 341. | 74. |
| 1990 | 485. | 853. | 558. | 72. | 216. | 331. | 348. | 75. |

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 36. | 50. | 52. | 1001. | 21. |
| 1963 | 29. | 27. | 50. | -8. | 50. | 697. | 99. |
| 1964 | 31. | 29. | 49. | 7. | 54. | 694. | 101. |
| 1965 | 33. | 33. | 35. | 57. | 65. | 690. | 103. |
| 1966 | 33. | 30. | 56. | 109. | 74. | 682. | 106. |
| 1967 | 30. | 38. | 39. | -38. | 45. | 679. | 103. |
| 1968 | 33. | 35. | 50. | 29. | 60. | 673. | 104. |
| 1969 | 34. | 35. | 51. | 31. | 62. | 669. | 105. |
| 1970 | 35. | 38. | 52. | 31. | 63. | 665. | 105. |
| 1971 | 36. | 39. | 54. | 34. | 64. | 660. | 106. |
| 1972 | 37. | 40. | 55. | 35. | 67. | 657. | 108. |
| 1973 | 38. | 41. | 57. | 36. | 67. | 652. | 109. |
| 1974 | 41. | 42. | 57. | 38. | 69. | 649. | 111. |
| 1975 | 41. | 44. | 59. | 40. | 71. | 645. | 111. |
| 1976 | 43. | 45. | 61. | 40. | 72. | 640. | 113. |
| 1977 | 44. | 46. | 62. | 42. | 73. | 636. | 113. |
| 1978 | 45. | 48. | 64. | 43. | 76. | 629. | 115. |
| 1979 | 46. | 48. | 64. | 44. | 76. | 624. | 117. |
| 1980 | 47. | 50. | 66. | 44. | 78. | 616. | 117. |
| 1981 | 35. | 35. | 50. | 40. | 59. | 595. | 112. |
| 1982 | 36. | 36. | 51. | 39. | 61. | 586. | 114. |
| 1983 | 36. | 37. | 51. | 41. | 60. | 577. | 113. |
| 1984 | 37. | 36. | 52. | 41. | 61. | 565. | 114. |
| 1985 | 37. | 37. | 51. | 41. | 61. | 555. | 113. |
| 1986 | 37. | 37. | 52. | 40. | 61. | 542. | 114. |
| 1987 | 38. | 38. | 52. | 41. | 61. | 530. | 114. |
| 1988 | 37. | 37. | 52. | 41. | 62. | 519. | 114. |
| 1989 | 38. | 37. | 52. | 40. | 62. | 504. | 113. |
| 1990 | 38. | 38. | 51. | 41. | 62. | 492. | 113. |

Table I-22

# P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | ACTUARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 93. | 65. | 25. | 374. | 897. | 22128. | 162555. |
| 1963 | 121. | 93. | 33. | 368. | 1120. | 19465. | 161413. |
| 1964 | 137. | 102. | 38. | 371. | 1221. | 20569. | 174287. |
| 1965 | 144. | 108. | 40. | 373. | 1190. | 21147. | 215725. |
| 1966 | 127. | 97. | 35. | 377. | 1366. | 20381. | 235937. |
| 1967 | 90. | 73. | 24. | 378. | 836. | 17488. | 119799. |
| 1968 | 114. | 90. | 32. | 381. | 1059. | 18887. | 159550. |
| 1969 | 117. | 92. | 31. | 384. | 1087. | 19026. | 164656. |
| 1970 | 122. | 95. | 33. | 385. | 1116. | 19162. | 168404. |
| 1971 | 124. | 98. | 35. | 388. | 1143. | 19297. | 164951. |
| 1972 | 128. | 100. | 34. | 390. | 1172. | 19429. | 171638. |
| 1973 | 131. | 103. | 36. | 390. | 1200. | 19560. | 175517. |
| 1974 | 136. | 106. | 37. | 393. | 1229. | 19690. | 177868. |
| 1975 | 139. | 109. | 39. | 393. | 1256. | 19819. | 181284. |
| 1976 | 142. | 112. | 40. | 394. | 1284. | 19948. | 183711. |
| 1977 | 145. | 115. | 42. | 395. | 1312. | 20077. | 186683. |
| 1978 | 148. | 117. | 42. | 395. | 1337. | 20205. | 189577. |
| 1979 | 152. | 121. | 45. | 395. | 1365. | 20334. | 192492. |
| 1980 | 155. | 122. | 45. | 396. | 1390. | 20464. | 195417. |
| 1981 | 143. | 111. | 44. | 331. | 1301. | 19657. | 197720. |
| 1982 | 144. | 113. | 44. | 328. | 1321. | 19739. | 200777. |
| 1983 | 148. | 114. | 46. | 326. | 1341. | 19819. | 203939. |
| 1984 | 149. | 116. | 48. | 321. | 1359. | 19896. | 207045. |
| 1985 | 151. | 118. | 48. | 319. | 1379. | 19970. | 210250. |
| 1986 | 153. | 120. | 49. | 316. | 1397. | 20041. | 213601. |
| 1987 | 155. | 120. | 51. | 313. | 1417. | 20109. | 216842. |
| 1988 | 157. | 123. | 51. | 310. | 1435. | 20181. | 220143. |
| 1989 | 159. | 125. | 53. | 307. | 1455. | 20247. | 223569. |
| 1990 | 161. | 125. | 53. | 304. | 1475. | 20312. | 227026. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 211. | 636. | 383. | 2. | 123. | 206. | 202. | 3. |
| 1963 | 330. | 722. | 412. | 7. | 62. | 242. | 158. | 13. |
| 1964 | 353. | 604. | 457. | 42. | 141. | 298. | 259. | 41. |
| 1965 | 383. | 607. | 492. | 67. | 100. | 323. | 226. | 61. |
| 1966 | 494. | 655. | 472. | 11. | 134. | 271. | 209. | 12. |
| 1967 | 306. | 305. | 188. | 115. | 50. | 110. | 156. | 105. |
| 1968 | 349. | 506. | 352. | 54. | 119. | 216. | 215. | 52. |
| 1969 | 358. | 527. | 366. | 56. | 125. | 223. | 224. | 54. |
| 1970 | 367. | 549. | 379. | 57. | 130. | 232. | 232. | 56. |
| 1971 | 377. | 571. | 392. | 58. | 137. | 239. | 241. | 58. |
| 1972 | 388. | 595. | 407. | 59. | 143. | 248. | 251. | 58. |
| 1973 | 398. | 61[illegible]. | 422. | 60. | 149. | 257. | 259. | 61. |
| 1974 | 409. | 642. | 437. | 61. | 156. | 266. | 270. | 63. |
| 1975 | 420. | 666. | 453. | 63. | 163. | 274. | 279. | 64. |
| 1976 | 432. | 691. | 468. | 63. | 171. | 284. | 290. | 66. |
| 1977 | 442. | 717. | 484. | 64. | 178. | 293. | 299. | 68. |
| 1978 | 455. | 741. | 498. | 66. | 184. | 302. | 310. | 69. |
| 1979 | 465. | 766. | 514. | 66. | 193. | 312. | 319. | 72. |
| 1980 | 477. | 791. | 529. | 67. | 199. | 321. | 331. | 74. |
| 1981 | 432. | 803. | 533. | 64. | 199. | 316. | 315. | 66. |
| 1982 | 441. | 827. | 547. | 64. | 207. | 324. | 325. | 67. |
| 1983 | 448. | 852. | 560. | 66. | 214. | 332. | 334. | 69. |
| 1984 | 456. | 876. | 575. | 65. | 221. | 342. | 343. | 69. |
| 1985 | 463. | 901. | 588. | 66. | 229. | 349. | 352. | 70. |
| 1986 | 469. | 926. | 603. | 68. | 235. | 358. | 361. | 72. |
| 1987 | 475. | 951. | 617. | 68. | 243. | 366. | 371. | 73. |
| 1988 | 482. | 977. | 631. | 68. | 251. | 375. | 382. | 73. |
| 1989 | 487. | 1004. | 645. | 70. | 258. | 384. | 390. | 75. |
| 1990 | 494. | 1031. | 659. | 70. | 267. | 391. | 401. | 75. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 35. | 50. | 50. | 1002. | 21. |
| 1963 | 30. | 26. | 49. | -9. | 47. | 698. | 100. |
| 1964 | 32. | 30. | 47. | 7. | 54. | 693. | 101. |
| 1965 | 33. | 33. | 33. | 57. | 59. | 691. | 104. |
| 1966 | 35. | 29. | 55. | 109. | 73. | 682. | 109. |
| 1967 | 29. | 38. | 41. | -38. | 45. | 680. | 101. |
| 1968 | 33. | 35. | 50. | 29. | 60. | 673. | 105. |
| 1969 | 35. | 36. | 52. | 31. | 62. | 670. | 105. |
| 1970 | 36. | 38. | 52. | 31. | 63. | 665. | 105. |
| 1971 | 36. | 39. | 54. | 34. | 64. | 661. | 106. |
| 1972 | 38. | 40. | 56. | 35. | 67. | 658. | 108. |
| 1973 | 40. | 41. | 57. | 37. | 67. | 653. | 109. |
| 1974 | 41. | 42. | 59. | 38. | 69. | 650. | 111. |
| 1975 | 43. | 44. | 59. | 40. | 72. | 646. | 112. |
| 1976 | 43. | 45. | 62. | 40. | 72. | 641. | 112. |
| 1977 | 45. | 47. | 63. | 42. | 73. | 636. | 114. |
| 1978 | 46. | 47. | 65. | 44. | 76. | 632. | 115. |
| 1979 | 48. | 49. | 65. | 44. | 77. | 625. | 117. |
| 1980 | 48. | 49. | 67. | 45. | 78. | 618. | 117. |
| 1981 | 37. | 36. | 52. | 39. | 60. | 596. | 113. |
| 1982 | 37. | 36. | 52. | 40. | 61. | 587. | 113. |
| 1983 | 38. | 37. | 52. | 42. | 61. | 578. | 114. |
| 1984 | 38. | 37. | 53. | 41. | 61. | 567. | 113. |
| 1985 | 39. | 37. | 53. | 41. | 61. | 557. | 114. |
| 1986 | 39. | 37. | 54. | 41. | 62. | 544. | 114. |
| 1987 | 39. | 37. | 53. | 41. | 63. | 532. | 114. |
| 1988 | 40. | 38. | 54. | 41. | 62. | 520. | 114. |
| 1989 | 40. | 37. | 55. | 41. | 63. | 507. | 113. |
| 1990 | 40. | 38. | 53. | 41. | 63. | 494. | 114. |

Table 1-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 117. | 80. | 33. | 374. | 948. | 22175. | 162389. |
| 1963 | 153. | 109. | 44. | 369. | 1212. | 19533. | 161060. |
| 1964 | 146. | 102. | 38. | 372. | 1287. | 20878. | 177106. |
| 1965 | 173. | 120. | 49. | 373. | 1234. | 21099. | 215283. |
| 1966 | 138. | 97. | 34. | 377. | 1502. | 21317. | 239214. |
| 1967 | 99. | 84. | 29. | 377. | 821. | 17300. | 118125. |
| 1968 | 122. | 95. | 35. | 382. | 1104. | 19278. | 163994. |
| 1969 | 126. | 99. | 35. | 384. | 1135. | 19448. | 169443. |
| 1970 | 130. | 102. | 37. | 386. | 1166. | 19616. | 173554. |
| 1971 | 134. | 105. | 38. | 387. | 1199. | 19785. | 170486. |
| 1972 | 138. | 109. | 39. | 390. | 1230. | 19952. | 177583. |
| 1973 | 141. | 111. | 40. | 391. | 1263. | 20119. | 181898. |
| 1974 | 146. | 115. | 42. | 393. | 1295. | 20288. | 184706. |
| 1975 | 151. | 118. | 43. | 393. | 1327. | 20459. | 188609. |
| 1976 | 154. | 122. | 46. | 394. | 1359. | 20630. | 191552. |
| 1977 | 158. | 125. | 47. | 396. | 1392. | 20804. | 195066. |
| 1978 | 163. | 128. | 48. | 395. | 1422. | 20981. | 198535. |
| 1979 | 166. | 132. | 50. | 396. | 1455. | 21158. | 202055. |
| 1980 | 170. | 136. | 52. | 395. | 1487. | 21341. | 205621. |
| 1981 | 158. | 124. | 51. | 332. | 1403. | 20588. | 208598. |
| 1982 | 163. | 126. | 52. | 329. | 1430. | 20727. | 212367. |
| 1983 | 164. | 129. | 53. | 325. | 1455. | 20868. | 216277. |
| 1984 | 169. | 132. | 56. | 322. | 1481. | 21008. | 220173. |
| 1985 | 172. | 134. | 56. | 320. | 1507. | 21149. | 224208. |
| 1986 | 174. | 137. | 58. | 316. | 1534. | 21289. | 228433. |
| 1987 | 178. | 139. | 60. | 313. | 1561. | 21430. | 232595. |
| 1988 | 181. | 141. | 62. | 311. | 1587. | 21578. | 236866. |
| 1989 | 184. | 144. | 63. | 307. | 1616. | 21724. | 241310. |
| 1990 | 187. | 146. | 64. | 305. | 1646. | 21875. | 245842. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF COOL'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE:  MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 208. | 545. | 339. | 5. | 136. | 188. | 228. | 4. |
| 1963 | 332. | 552. | 351. | 12. | 132. | 216. | 226. | 14. |
| 1964 | 344. | 657. | 400. | 44. | 164. | 256. | 278. | 42. |
| 1965 | 392. | 724. | 426. | 68. | 177. | 276. | 302. | 61. |
| 1966 | 480. | 589. | 377. | 13. | 136. | 233. | 231. | 13. |
| 1967 | 322. | 289. | 244. | 113. | 61. | 154. | 154. | 105. |
| 1968 | 352. | 493. | 336. | 55. | 116. | 209. | 216. | 52. |
| 1969 | 359. | 513. | 350. | 57. | 121. | 217. | 225. | 54. |
| 1970 | 370. | 534. | 363. | 58. | 126. | 224. | 232. | 55. |
| 1971 | 379. | 556. | 376. | 59. | 132. | 232. | 243. | 56. |
| 1972 | 391. | 579. | 390. | 61. | 138. | 240. | 251. | 56. |
| 1973 | 401. | 600. | 403. | 61. | 145. | 249. | 260. | 61. |
| 1974 | 412. | 625. | 417. | 63. | 151. | 257. | 270. | 63. |
| 1975 | 423. | 647. | 432. | 63. | 157. | 265. | 280. | 65. |
| 1976 | 435. | 671. | 445. | 65. | 164. | 274. | 290. | 66. |
| 1977 | 447. | 696. | 461. | 66. | 171. | 282. | 300. | 67. |
| 1978 | 458. | 719. | 474. | 57. | 178. | 292. | 309. | 70. |
| 1979 | 470. | 743. | 489. | 66. | 185. | 299. | 321. | 72. |
| 1980 | 481. | 767. | 502. | 63. | 192. | 309. | 331. | 73. |
| 1981 | 437. | 777. | 505. | 66. | 192. | 303. | 316. | 67. |
| 1982 | 445. | 800. | 517. | 66. | 198. | 310. | 325. | 67. |
| 1983 | 453. | 824. | 531. | 58. | 205. | 319. | 334. | 69. |
| 1984 | 461. | 847. | 543. | 66. | 212. | 325. | 344. | 69. |
| 1985 | 469. | 870. | 554. | 69. | 216. | 334. | 353. | 70. |
| 1986 | 475. | 893. | 567. | 69. | 226. | 342. | 362. | 72. |
| 1987 | 481. | 916. | 580. | 71. | 232. | 348. | 371. | 73. |
| 1988 | 488. | 941. | 592. | 71. | 239. | 357. | 382. | 74. |
| 1989 | 494. | 966. | 604. | 72. | 246. | 364. | 390. | 75. |
| 1990 | 501. | 991. | 618. | 73. | 253. | 373. | 400. | 75. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT
--------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 36. | 50. | 52. | 1001. | 21. |
| 1963 | 29. | 27. | 50. | -8. | 50. | 697. | 99. |
| 1964 | 31. | 29. | 49. | 7. | 54. | 694. | 101. |
| 1965 | 33. | 33. | 35. | 57. | 55. | 690. | 103. |
| 1966 | 33. | 30. | 56. | 109. | 74. | 682. | 108. |
| 1967 | 30. | 38. | 39. | -38. | 45. | 679. | 103. |
| 1968 | 33. | 35. | 51. | 29. | 60. | 673. | 104. |
| 1969 | 34. | 35. | 51. | 31. | 63. | 670. | 105. |
| 1970 | 36. | 38. | 53. | 3[illegible]. | 63. | 665. | 105. |
| 1971 | 36. | 39. | 53. | 34. | 65. | 660. | 107. |
| 1972 | 38. | 40. | 56. | 35. | 57. | 658. | 107. |
| 1973 | 39. | 41. | 57. | 36. | 58. | 653. | 110. |
| 1974 | 41. | 43. | 58. | 39. | 70. | 649. | 110. |
| 1975 | 42. | 44. | 60. | 39. | 71. | 646. | 112. |
| 1976 | 43. | 45. | 61. | 41. | 73. | 640. | 113. |
| 1977 | 45. | 46. | 63. | 42. | 74. | 636. | 114. |
| 1978 | 45. | 48. | 64. | 43. | 75. | 631. | 115. |
| 1979 | 47. | 49. | 65. | 44. | 76. | 625. | 117. |
| 1980 | 48. | 49. | 66. | 44. | 79. | 617. | 117. |
| 1981 | 37. | 36. | 52. | 40. | 60. | 596. | 113. |
| 1982 | 36. | 36. | 51. | 40. | 61. | 587. | 113. |
| 1983 | 38. | 37. | 52. | 41. | 62. | 577. | 114. |
| 1984 | 38. | 37. | 53. | 41. | 62. | 566. | 113. |
| 1985 | 38. | 37. | 52. | 41. | 62. | 556. | 114. |
| 1986 | 38. | 37. | 53. | 40. | 62. | 543. | 114. |
| 1987 | 39. | 38. | 53. | 41. | 63. | 532. | 114. |
| 1988 | 38. | 37. | 53. | 42. | 63. | 519. | 115. |
| 1989 | 40. | 33. | 54. | 40. | 64. | 506. | 113. |
| 1990 | 39. | 37. | 52. | 41. | 64. | 493. | 114. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | ACTUARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 93. | 66. | 25. | 374. | 897. | 22128. | 162555. |
| 1963 | 121. | 93. | 33. | 368. | 1120. | 19465. | 161413. |
| 1964 | 137. | 102. | 38. | 371. | 1221. | 20569. | 174287. |
| 1965 | 144. | 108. | 40. | 373. | 1190. | 21147. | 215725. |
| 1966 | 127. | 97. | 35. | 377. | 1366. | 20381. | 235937. |
| 1967 | 90. | 73. | 24. | 378. | 836. | 17488. | 119799. |
| 1968 | 118. | 92. | 33. | 381. | 1091. | 19176. | 164353. |
| 1969 | 122. | 96. | 33. | 384. | 1122. | 19339. | 169824. |
| 1970 | 127. | 98. | 34. | 386. | 1154. | 19498. | 173957. |
| 1971 | 130. | 101. | 36. | 388. | 1185. | 19656. | 170913. |
| 1972 | 134. | 104. | 36. | 390. | 1215. | 19815. | 178030. |
| 1973 | 137. | 107. | 38. | 391. | 1246. | 19973. | 182364. |
| 1974 | 142. | 110. | 39. | 393. | 1278. | 20133. | 185194. |
| 1975 | 146. | 114. | 40. | 393. | 1310. | 20291. | 189114. |
| 1976 | 150. | 116. | 42. | 394. | 1340. | 20453. | 192076. |
| 1977 | 153. | 120. | 44. | 396. | 1372. | 20615. | 195610. |
| 1978 | 157. | 123. | 45. | 395. | 1403. | 20780. | 199098. |
| 1979 | 161. | 126. | 47. | 396. | 1433. | 20947. | 202638. |
| 1980 | 165. | 129. | 48. | 395. | 1464. | 21116. | 206222. |
| 1981 | 153. | 117. | 46. | 332. | 1379. | 20351. | 209220. |
| 1982 | 156. | 120. | 48. | 329. | 1405. | 20478. | 213009. |
| 1983 | 159. | 122. | 49. | 326. | 1429. | 20604. | 216943. |
| 1984 | 161. | 124. | 51. | 322. | 1453. | 20730. | 220862. |
| 1985 | 165. | 126. | 52. | 319. | 1479. | 20856. | 224924. |
| 1986 | 167. | 128. | 53. | 316. | 1503. | 20981. | 229177. |
| 1987 | 170. | 131. | 54. | 314. | 1529. | 21107. | 233367. |
| 1988 | 173. | 133. | 56. | 310. | 1554. | 21239. | 237671. |
| 1989 | 176. | 135. | 57. | 308. | 1581. | 21369. | 242150. |
| 1990 | 179. | 137. | 58. | 305. | 1609. | 21500. | 246719. |

Table I-22

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT
--------

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 211. | 638. | 383. | 2. | 123. | 206. | 202. | 3. |
| 1963 | 330. | 722. | 412. | 7. | 62. | 242. | 158. | 13. |
| 1964 | 353. | 804. | 457. | 42. | 141. | 298. | 259. | 41. |
| 1965 | 383. | 807. | 492. | 67. | 100. | 323. | 226. | 61. |
| 1966 | 494. | 855. | 472. | 11. | 134. | 271. | 209. | 12. |
| 1967 | 306. | 305. | 188. | 115. | 50. | 110. | 156. | 105. |
| 1968 | 353. | 546. | 369. | 54. | 128. | 228. | 226. | 52. |
| 1969 | 362. | 571. | 384. | 56. | 134. | 237. | 236. | 55. |
| 1970 | 372. | 595. | 398. | 58. | 141. | 245. | 245. | 56. |
| 1971 | 382. | 623. | 414. | 58. | 149. | 255. | 255. | 57. |
| 1972 | 394. | 650. | 430. | 60. | 156. | 266. | 266. | 59. |
| 1973 | 404. | 677. | 448. | 60. | 163. | 276. | 277. | 61. |
| 1974 | 415. | 706. | 464. | 63. | 171. | 286. | 287. | 63. |
| 1975 | 427. | 736. | 482. | 62. | 179. | 296. | 299. | 65. |
| 1976 | 439. | 766. | 500. | 64. | 188. | 307. | 310. | 67. |
| 1977 | 451. | 796. | 518. | 65. | 196. | 318. | 322. | 68. |
| 1978 | 463. | 826. | 536. | 67. | 205. | 329. | 333. | 69. |
| 1979 | 475. | 858. | 555. | 67. | 214. | 341. | 345. | 73. |
| 1980 | 486. | 890. | 572. | 67. | 224. | 352. | 358. | 74. |
| 1981 | 443. | 908. | 579. | 65. | 225. | 350. | 346. | 67. |
| 1982 | 451. | 940. | 597. | 65. | 233. | 362. | 356. | 67. |
| 1983 | 460. | 972. | 615. | 67. | 243. | 372. | 368. | 69. |
| 1984 | 468. | 1006. | 633. | 66. | 252. | 383. | 379. | 70. |
| 1985 | 476. | 1039. | 651. | 68. | 262. | 395. | 391. | 71. |
| 1986 | 483. | 1074. | 669. | 68. | 271. | 406. | 403. | 73. |
| 1987 | 490. | 1108. | 688. | 70. | 281. | 418. | 416. | 73. |
| 1988 | 497. | 1145. | 707. | 69. | 291. | 430. | 427. | 75. |
| 1989 | 504. | 1183. | 727. | 71. | 301. | 442. | 440. | 75. |
| 1990 | 511. | 1223. | 746. | 72. | 312. | 455. | 454. | 76. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI- NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 35. | 50. | 50. | 1002. | 21. |
| 1963 | 30. | 26. | 49. | -9. | 47. | 698. | 100. |
| 1964 | 32. | 30. | 47. | 7. | 54. | 693. | 101. |
| 1965 | 33. | 33. | 33. | 57. | 59. | 691. | 104. |
| 1966 | 35. | 29. | 55. | 109. | 73. | 682. | 109. |
| 1967 | 29. | 38. | 41. | -38. | 45. | 680. | 101. |
| 1968 | 34. | 35. | 50. | 29. | 60. | 674. | 105. |
| 1969 | 35. | 36. | 52. | 31. | 62. | 670. | 105. |
| 1970 | 36. | 38. | 53. | 32. | 64. | 665. | 106. |
| 1971 | 38. | 39. | 54. | 34. | 64. | 662. | 106. |
| 1972 | 38. | 40. | 56. | 35. | 67. | 657. | 108. |
| 1973 | 41. | 41. | 57. | 36. | 68. | 654. | 110. |
| 1974 | 42. | 43. | 59. | 38. | 69. | 651. | 110. |
| 1975 | 43. | 44. | 60. | 40. | 72. | 646. | 112. |
| 1976 | 45. | 45. | 62. | 41. | 73. | 642. | 113. |
| 1977 | 46. | 47. | 63. | 42. | 74. | 636. | 114. |
| 1978 | 47. | 47. | 65. | 43. | 76. | 632. | 116. |
| 1979 | 48. | 49. | 66. | 45. | 77. | 626. | 117. |
| 1980 | 50. | 50. | 67. | 44. | 79. | 618. | 117. |
| 1981 | 38. | 36. | 52. | 40. | 60. | 597. | 113. |
| 1982 | 39. | 36. | 52. | 41. | 62. | 589. | 114. |
| 1983 | 39. | 37. | 53. | 41. | 61. | 578. | 113. |
| 1984 | 40. | 37. | 53. | 42. | 62. | 568. | 114. |
| 1985 | 41. | 38. | 54. | 40. | 63. | 557. | 115. |
| 1986 | 41. | 37. | 54. | 41. | 62. | 546. | 114. |
| 1987 | 41. | 38. | 54. | 42. | 64. | 533. | 114. |
| 1988 | 42. | 38. | 55. | 41. | 63. | 521. | 115. |
| 1989 | 42. | 37. | 54. | 41. | 64. | 508. | 114. |
| 1990 | 42. | 39. | 55. | 41. | 64. | 495. | 113. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT
--------

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 117. | 80. | 33. | 374. | 948. | 22175. | 162389. |
| 1963 | 153. | 109. | 44. | 369. | 1212. | 19533. | 161060. |
| 1964 | 146. | 102. | 38. | 372. | 1287. | 20878. | 177106. |
| 1965 | 173. | 120. | 49. | 373. | 1234. | 21099. | 215283. |
| 1966 | 138. | 97. | 34. | 377. | 1502. | 21317. | 239214. |
| 1967 | 99. | 84. | 29. | 377. | 821. | 17300. | 118125. |
| 1968 | 127. | 99. | 36. | 382. | 1139. | 19577. | 168893. |
| 1969 | 132. | 102. | 37. | 384. | 1174. | 19773. | 174765. |
| 1970 | 137. | 105. | 39. | 386. | 1208. | 19973. | 179323. |
| 1971 | 140. | 110. | 40. | 388. | 1244. | 20170. | 176733. |
| 1972 | 145. | 112. | 40. | 390. | 1279. | 20371. | 184332. |
| 1973 | 151. | 116. | 43. | 391. | 1316. | 20575. | 189179. |
| 1974 | 154. | 120. | 44. | 394. | 1353. | 20781. | 192555. |
| 1975 | 160. | 124. | 47. | 393. | 1389. | 20991. | 197057. |
| 1976 | 164. | 128. | 48. | 395. | 1426. | 21206. | 200639. |
| 1977 | 168. | 131. | 50. | 395. | 1463. | 21425. | 204829. |
| 1978 | 174. | 135. | 52. | 396. | 1501. | 21650. | 209016. |
| 1979 | 177. | 139. | 54. | 396. | 1539. | 21879. | 213301. |
| 1980 | 183. | 143. | 56. | 396. | 1576. | 22116. | 217676. |
| 1981 | 172. | 133. | 55. | 332. | 1499. | 21421. | 221514. |
| 1982 | 176. | 135. | 56. | 329. | 1533. | 21621. | 226196. |
| 1983 | 180. | 139. | 59. | 327. | 1567. | 21828. | 231076. |
| 1984 | 185. | 141. | 60. | 322. | 1600. | 22036. | 236001. |
| 1985 | 189. | 145. | 63. | 320. | 1634. | 22250. | 241127. |
| 1986 | 193. | 148. | 65. | 317. | 1670. | 22468. | 246512. |
| 1987 | 197. | 151. | 66. | 314. | 1707. | 22692. | 251901. |
| 1988 | 202. | 154. | 69. | 312. | 1744. | 22926. | 257476. |
| 1989 | 206. | 157. | 70. | 308. | 1782. | 23166. | 263300. |
| 1990 | 212. | 162. | 73. | 306. | 1823. | 23413. | 269295. |

Table I-22

(Page 15 of 72)
Projection 5-A

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 208. | 545. | 339. | 5. | 138. | 188. | 228. | 4. |
| 1963 | 332. | 552. | 351. | 12. | 132. | 218. | 226. | 14. |
| 1964 | 344. | 667. | 400. | 44. | 164. | 256. | 278. | 42. |
| 1965 | 392. | 724. | 426. | 68. | 177. | 278. | 302. | 61. |
| 1966 | 480. | 589. | 377. | 13. | 136. | 233. | 231. | 13. |
| 1967 | 322. | 289. | 244. | 113. | 61. | 154. | 154. | 105. |
| 1968 | 355. | 527. | 353. | 56. | 125. | 220. | 229. | 52. |
| 1969 | 364. | 550. | 365. | 57. | 131. | 227. | 238. | 54. |
| 1970 | 374. | 574. | 380. | 58. | 136. | 236. | 248. | 57. |
| 1971 | 385. | 599. | 394. | 60. | 144. | 245. | 258. | 57. |
| 1972 | 395. | 625. | 409. | 61. | 151. | 254. | 269. | 60. |
| 1973 | 407. | 652. | 425. | 62. | 158. | 264. | 279. | 60. |
| 1974 | 419. | 679. | 441. | 63. | 165. | 273. | 291. | 64. |
| 1975 | 429. | 707. | 456. | 64. | 173. | 283. | 302. | 64. |
| 1976 | 442. | 734. | 472. | 66. | 181. | 292. | 314. | 67. |
| 1977 | 454. | 763. | 489. | 67. | 189. | 303. | 324. | 68. |
| 1978 | 467. | 792. | 505. | 67. | 198. | 313. | 338. | 70. |
| 1979 | 479. | 821. | 521. | 69. | 205. | 322. | 350. | 72. |
| 1980 | 491. | 851. | 539. | 70. | 214. | 334. | 363. | 74. |
| 1981 | 447. | 867. | 542. | 66. | 216. | 329. | 349. | 67. |
| 1982 | 457. | 897. | 557. | 68. | 224. | 339. | 361. | 67. |
| 1983 | 465. | 927. | 574. | 69. | 233. | 349. | 372. | 70. |
| 1984 | 473. | 957. | 589. | 69. | 241. | 360. | 385. | 70. |
| 1985 | 482. | 987. | 605. | 70. | 250. | 368. | 396. | 71. |
| 1986 | 489. | 1020. | 620. | 71. | 259. | 379. | 409. | 72. |
| 1987 | 496. | 1051. | 636. | 72. | 267. | 389. | 421. | 74. |
| 1988 | 504. | 1085. | 652. | 73. | 278. | 399. | 434. | 74. |
| 1989 | 512. | 1119. | 670. | 74. | 286. | 411. | 448. | 76. |
| 1990 | 520. | 1154. | 686. | 75. | 297. | 420. | 461. | 76. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 36. | 50. | 52. | 1001. | 21. |
| 1963 | 29. | 27. | 50. | -8. | 50. | 697. | 99. |
| 1964 | 31. | 29. | 49. | 7. | 54. | 694. | 101. |
| 1965 | 33. | 33. | 35. | 57. | 65. | 690. | 103. |
| 1966 | 33. | 30. | 56. | 109. | 74. | 682. | 108. |
| 1967 | 30. | 38. | 39. | -38. | 45. | 679. | 103. |
| 1968 | 33. | 35. | 51. | 29. | 61. | 674. | 104. |
| 1969 | 35. | 36. | 52. | 31. | 63. | 670. | 105. |
| 1970 | 36. | 38. | 53. | 32. | 64. | 665. | 106. |
| 1971 | 37. | 39. | 54. | 34. | 65. | 661. | 106. |
| 1972 | 38. | 40. | 56. | 35. | 68. | 657. | 108. |
| 1973 | 40. | 41. | 57. | 36. | 68. | 654. | 109. |
| 1974 | 41. | 42. | 59. | 38. | 71. | 650. | 111. |
| 1975 | 43. | 45. | 60. | 40. | 72. | 646. | 112. |
| 1976 | 44. | 45. | 62. | 41. | 73. | 641. | 113. |
| 1977 | 45. | 47. | 64. | 42. | 75. | 637. | 114. |
| 1978 | 47. | 47. | 64. | 43. | 77. | 632. | 115. |
| 1979 | 47. | 49. | 66. | 44. | 79. | 625. | 118. |
| 1980 | 49. | 50. | 67. | 45. | 80. | 618. | 117. |
| 1981 | 38. | 36. | 53. | 40. | 61. | 597. | 113. |
| 1982 | 37. | 36. | 52. | 40. | 62. | 587. | 113. |
| 1983 | 39. | 37. | 53. | 41. | 63. | 579. | 114. |
| 1984 | 39. | 37. | 53. | 41. | 63. | 567. | 114. |
| 1985 | 39. | 38. | 54. | 41. | 64. | 557. | 114. |
| 1986 | 40. | 37. | 54. | 41. | 64. | 545. | 115. |
| 1987 | 40. | 38. | 54. | 41. | 65. | 532. | 114. |
| 1988 | 41. | 38. | 55. | 41. | 65. | 521. | 115. |
| 1989 | 40. | 38. | 55. | 41. | 65. | 507. | 114. |
| 1990 | 42. | 38. | 54. | 41. | 66. | 494. | 114. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT
--------

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 93. | 66. | 25. | 374. | 897. | 22128. | 162555. |
| 1963 | 121. | 93. | 33. | 368. | 1120. | 19465. | 161413. |
| 1964 | 137. | 102. | 38. | 371. | 1221. | 20569. | 174287. |
| 1965 | 144. | 108. | 40. | 373. | 1190. | 21147. | 215725. |
| 1966 | 127. | 97. | 35. | 377. | 1366. | 20381. | 235937. |
| 1967 | 90. | 73. | 24. | 378. | 836. | 17488. | 119799. |
| 1968 | 123. | 95. | 34. | 381. | 1124. | 19466. | 169156. |
| 1969 | 127. | 98. | 34. | 384. | 1158. | 19653. | 175040. |
| 1970 | 131. | 102. | 36. | 386. | 1192. | 19839. | 179614. |
| 1971 | 136. | 104. | 37. | 388. | 1226. | 20026. | 177036. |
| 1972 | 140. | 108. | 38. | 391. | 1260. | 20214. | 184650. |
| 1973 | 144. | 111. | 39. | 391. | 1296. | 20404. | 189514. |
| 1974 | 149. | 115. | 41. | 393. | 1330. | 20598. | 192904. |
| 1975 | 153. | 118. | 43. | 394. | 1366. | 20793. | 197422. |
| 1976 | 158. | 122. | 44. | 395. | 1401. | 20993. | 201017. |
| 1977 | 162. | 125. | 46. | 395. | 1437. | 21195. | 205222. |
| 1978 | 167. | 129. | 48. | 396. | 1472. | 21404. | 209423. |
| 1979 | 171. | 133. | 49. | 396. | 1508. | 21616. | 213721. |
| 1980 | 176. | 136. | 52. | 396. | 1544. | 21834. | 218107. |
| 1981 | 165. | 126. | 49. | 332. | 1465. | 21120. | 221958. |
| 1982 | 169. | 127. | 50. | 330. | 1497. | 21301. | 226649. |
| 1983 | 172. | 130. | 53. | 326. | 1528. | 21484. | 231540. |
| 1984 | 176. | 134. | 55. | 323. | 1560. | 21673. | 236474. |
| 1985 | 180. | 136. | 56. | 320. | 1591. | 21863. | 241610. |
| 1986 | 184. | 138. | 57. | 317. | 1625. | 22057. | 247003. |
| 1987 | 188. | 142. | 59. | 314. | 1658. | 22257. | 252402. |
| 1988 | 192. | 144. | 61. | 311. | 1692. | 22464. | 257985. |
| 1989 | 195. | 147. | 62. | 309. | 1728. | 22677. | 263818. |
| 1990 | 200. | 150. | 64. | 305. | 1765. | 22895. | 269822. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT
--------

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 176. | 600. | 376. | -21. | 112. | 206. | 202. | 3. |
| 1963 | 291. | 682. | 405. | -14. | 50. | 242. | 158. | 13. |
| 1964 | 312. | 739. | 449. | 19. | 125. | 298. | 259. | 41. |
| 1965 | 328. | 766. | 483. | 38. | 82. | 323. | 226. | 61. |
| 1966 | 409. | 729. | 455. | -6. | 113. | 271. | 209. | 12. |
| 1967 | 248. | 252. | 177. | 68. | 36. | 110. | 156. | 105. |
| 1968 | 280. | 398. | 325. | 21. | 89. | 204. | 204. | 52. |
| 1969 | 285. | 413. | 336. | 20. | 93. | 210. | 212. | 54. |
| 1970 | 289. | 429. | 347. | 19. | 96. | 218. | 219. | 56. |
| 1971 | 295. | 445. | 360. | 18. | 100. | 224. | 227. | 57. |
| 1972 | 361. | 528. | 382. | 49. | 121. | 231. | 235. | 58. |
| 1973 | 371. | 546. | 396. | 50. | 127. | 240. | 244. | 60. |
| 1974 | 381. | 568. | 409. | 49. | 133. | 247. | 252. | 63. |
| 1975 | 391. | 586. | 422. | 51. | 138. | 255. | 261. | 64. |
| 1976 | 401. | 607. | 436. | 51. | 144. | 263. | 269. | 66. |
| 1977 | 412. | 626. | 448. | 52. | 149. | 270. | 279. | 67. |
| 1978 | 421. | 646. | 463. | 52. | 154. | 278. | 286. | 69. |
| 1979 | 432. | 665. | 474. | 52. | 160. | 284. | 296. | 72. |
| 1980 | 440. | 685. | 488. | 54. | 166. | 293. | 304. | 73. |
| 1981 | 396. | 690. | 488. | 49. | 164. | 287. | 288. | 66. |
| 1982 | 402. | 708. | 499. | 49. | 170. | 292. | 295. | 66. |
| 1983 | 408. | 725. | 511. | 50. | 174. | 300. | 302. | 68. |
| 1984 | 413. | 743. | 521. | 50. | 179. | 305. | 310. | 69. |
| 1985 | 419. | 759. | 532. | 49. | 183. | 312. | 317. | 70. |
| 1986 | 423. | 777. | 542. | 50. | 189. | 318. | 325. | 71. |
| 1987 | 427. | 794. | 552. | 51. | 193. | 322. | 331. | 72. |
| 1988 | 432. | 811. | 563. | 49. | 199. | 329. | 338. | 73. |
| 1989 | 436. | 827. | 572. | 51. | 203. | 335. | 345. | 74. |
| 1990 | 439. | 845. | 583. | 51. | 208. | 341. | 352. | 74. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT
--------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI- NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 35. | 63. | 50. | 1002. | 20. |
| 1963 | 30. | 26. | 49. | 3. | 47. | 698. | 98. |
| 1964 | 32. | 30. | 47. | 18. | 54. | 693. | 100. |
| 1965 | 33. | 33. | 33. | 73. | 59. | 692. | 102. |
| 1966 | 35. | 29. | 55. | 134. | 73. | 682. | 106. |
| 1967 | 29. | 38. | 41. | -32. | 45. | 680. | 99. |
| 1968 | 33. | 35. | 50. | 45. | 55. | 673. | 102. |
| 1969 | 34. | 36. | 51. | 46. | 62. | 670. | 103. |
| 1970 | 35. | 38. | 53. | 48. | 63. | 665. | 102. |
| 1971 | 36. | 38. | 54. | 51. | 64. | 662. | 103. |
| 1972 | 38. | 40. | 55. | 37. | 66. | 657. | 107. |
| 1973 | 38. | 41. | 57. | 39. | 68. | 653. | 109. |
| 1974 | 41. | 42. | 59. | 41. | 68. | 649. | 109. |
| 1975 | 42. | 44. | 59. | 42. | 71. | 646. | 111. |
| 1976 | 43. | 45. | 62. | 43. | 72. | 641. | 112. |
| 1977 | 44. | 47. | 62. | 44. | 73. | 636. | 112. |
| 1978 | 45. | 47. | 64. | 46. | 75. | 631. | 114. |
| 1979 | 46. | 48. | 65. | 47. | 77. | 624. | 115. |
| 1980 | 48. | 50. | 67. | 48. | 78. | 618. | 116. |
| 1981 | 35. | 35. | 51. | 42. | 58. | 596. | 111. |
| 1982 | 36. | 36. | 52. | 44. | 60. | 587. | 112. |
| 1983 | 37. | 37. | 52. | 44. | 61. | 577. | 112. |
| 1984 | 37. | 36. | 53. | 44. | 60. | 566. | 113. |
| 1985 | 37. | 37. | 52. | 45. | 61. | 556. | 112. |
| 1986 | 38. | 37. | 53. | 44. | 61. | 544. | 112. |
| 1987 | 37. | 37. | 53. | 44. | 61. | 531. | 113. |
| 1988 | 38. | 37. | 54. | 45. | 62. | 520. | 113. |
| 1989 | 38. | 38. | 53. | 44. | 62. | 506. | 111. |
| 1990 | 38. | 37. | 53. | 44. | 62. | 493. | 112. |

Table 1-22

# PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 132. | 80. | 33. | 374. | 1059. | 22245. | 143703. |
| 1963 | 173. | 109. | 44. | 369. | 1344. | 19657. | 140197. |
| 1964 | 168. | 102. | 38. | 372. | 1442. | 21011. | 152984. |
| 1965 | 201. | 120. | 49. | 373. | 1402. | 21302. | 186887. |
| 1966 | 166. | 97. | 34. | 377. | 1725. | 21377. | 205871. |
| 1967 | 123. | 84. | 29. | 377. | 982. | 17363. | 91384. |
| 1968 | 146. | 92. | 34. | 382. | 1264. | 19122. | 127177. |
| 1969 | 151. | 96. | 33. | 383. | 1305. | 19278. | 130128. |
| 1970 | 156. | 98. | 35. | 386. | 1346. | 19433. | 131610. |
| 1971 | 161. | 102. | 36. | 388. | 1388. | 19585. | 125779. |
| 1972 | 140. | 104. | 37. | 389. | 1244. | 19603. | 160222. |
| 1973 | 144. | 107. | 38. | 391. | 1277. | 19744. | 163707. |
| 1974 | 148. | 110. | 40. | 393. | 1306. | 19883. | 165648. |
| 1975 | 152. | 113. | 41. | 392. | 1338. | 20021. | 168643. |
| 1976 | 156. | 116. | 42. | 394. | 1368. | 20160. | 170636. |
| 1977 | 160. | 119. | 44. | 395. | 1399. | 20299. | 173152. |
| 1978 | 163. | 123. | 46. | 395. | 1428. | 20437. | 175575. |
| 1979 | 168. | 125. | 47. | 395. | 1459. | 20576. | 178000. |
| 1980 | 171. | 129. | 48. | 396. | 1488. | 20716. | 180412. |
| 1981 | 160. | 117. | 46. | 331. | 1401. | 19919. | 182180. |
| 1982 | 163. | 118. | 48. | 328. | 1425. | 20012. | 184681. |
| 1983 | 165. | 120. | 49. | 325. | 1449. | 20104. | 187260. |
| 1984 | 169. | 123. | 51. | 322. | 1472. | 20192. | 189762. |
| 1985 | 170. | 125. | 51. | 318. | 1495. | 20278. | 192329. |
| 1986 | 174. | 125. | 53. | 316. | 1519. | 20361. | 195015. |
| 1987 | 176. | 129. | 55. | 313. | 1541. | 20442. | 197558. |
| 1988 | 179. | 130. | 55. | 310. | 1566. | 20526. | 200128. |
| 1989 | 182. | 131. | 56. | 306. | 1590. | 20606. | 202784. |
| 1990 | 185. | 134. | 58. | 304. | 1614. | 20685. | 205442. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 176. | 511. | 335. | -21. | 141. | 188. | 228. | 4. |
| 1963 | 297. | 512. | 347. | -11. | 136. | 218. | 226. | 14. |
| 1964 | 306. | 621. | 396. | 17. | 167. | 256. | 278. | 42. |
| 1965 | 344. | 670. | 420. | 34. | 182. | 278. | 302. | 61. |
| 1966 | 401. | 528. | 367. | -8. | 140. | 233. | 231. | 13. |
| 1967 | 268. | 237. | 236. | 62. | 65. | 154. | 154. | 105. |
| 1968 | 288. | 400. | 317. | 17. | 111. | 199. | 203. | 51. |
| 1969 | 293. | 413. | 327. | 16. | 116. | 206. | 211. | 55. |
| 1970 | 299. | 427. | 338. | 15. | 121. | 213. | 219. | 56. |
| 1971 | 304. | 442. | 350. | 14. | 127. | 219. | 226. | 57. |
| 1972 | 366. | 513. | 368. | 49. | 128. | 227. | 235. | 58. |
| 1973 | 376. | 533. | 380. | 49. | 133. | 233. | 242. | 61. |
| 1974 | 386. | 551. | 393. | 49. | 138. | 242. | 251. | 62. |
| 1975 | 397. | 571. | 406. | 51. | 145. | 248. | 259. | 65. |
| 1976 | 407. | 589. | 419. | 51. | 150. | 257. | 268. | 66. |
| 1977 | 417. | 609. | 431. | 51. | 156. | 263. | 277. | 67. |
| 1978 | 428. | 627. | 443. | 51. | 161. | 272. | 284. | 69. |
| 1979 | 438. | 646. | 455. | 52. | 168. | 278. | 294. | 72. |
| 1980 | 449. | 665. | 467. | 52. | 173. | 285. | 302. | 73. |
| 1981 | 403. | 669. | 467. | 49. | 172. | 279. | 286. | 66. |
| 1982 | 409. | 686. | 477. | 49. | 177. | 285. | 293. | 66. |
| 1983 | 415. | 703. | 488. | 49. | 183. | 291. | 301. | 69. |
| 1984 | 422. | 719. | 498. | 50. | 188. | 297. | 307. | 69. |
| 1985 | 427. | 735. | 508. | 49. | 193. | 302. | 314. | 70. |
| 1986 | 433. | 750. | 518. | 50. | 199. | 308. | 321. | 71. |
| 1987 | 436. | 767. | 526. | 50. | 203. | 314. | 327. | 72. |
| 1988 | 442. | 782. | 536. | 49. | 209. | 320. | 335. | 73. |
| 1989 | 446. | 798. | 545. | 50. | 214. | 325. | 341. | 74. |
| 1990 | 449. | 815. | 555. | 50. | 219. | 331. | 348. | 75. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT
--------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 36. | 63. | 52. | 1001. | 19. |
| 1963 | 29. | 27. | 50. | 3. | 50. | 697. | 98. |
| 1964 | 31. | 29. | 49. | 19. | 54. | 694. | 98. |
| 1965 | 33. | 33. | 35. | 73. | 65. | 691. | 100. |
| 1966 | 33. | 30. | 56. | 133. | 74. | 682. | 104. |
| 1967 | 30. | 38. | 39. | -31. | 45. | 678. | 100. |
| 1968 | 33. | 35. | 50. | 44. | 60. | 674. | 101. |
| 1969 | 34. | 35. | 51. | 46. | 62. | 669. | 101. |
| 1970 | 35. | 38. | 52. | 48. | 63. | 665. | 102. |
| 1971 | 36. | 39. | 54. | 50. | 64. | 660. | 102. |
| 1972 | 37. | 40. | 55. | 38. | 67. | 657. | 107. |
| 1973 | 38. | 41. | 57. | 38. | 67. | 653. | 108. |
| 1974 | 41. | 42. | 57. | 41. | 69. | 649. | 109. |
| 1975 | 41. | 44. | 59. | 42. | 71. | 645. | 111. |
| 1976 | 43. | 45. | 61. | 43. | 72. | 640. | 111. |
| 1977 | 44. | 46. | 62. | 44. | 73. | 635. | 113. |
| 1978 | 45. | 48. | 64. | 45. | 76. | 630. | 113. |
| 1979 | 46. | 48. | 64. | 47. | 76. | 624. | 115. |
| 1980 | 47. | 50. | 66. | 48. | 78. | 616. | 116. |
| 1981 | 35. | 35. | 50. | 42. | 59. | 595. | 110. |
| 1982 | 36. | 36. | 51. | 44. | 61. | 587. | 112. |
| 1983 | 36. | 37. | 51. | 43. | 60. | 576. | 112. |
| 1984 | 37. | 36. | 52. | 44. | 61. | 566. | 112. |
| 1985 | 37. | 37. | 51. | 45. | 61. | 554. | 112. |
| 1986 | 37. | 37. | 52. | 44. | 61. | 543. | 112. |
| 1987 | 38. | 38. | 52. | 44. | 61. | 530. | 112. |
| 1988 | 37. | 37. | 52. | 44. | 62. | 519. | 112. |
| 1989 | 38. | 37. | 52. | 44. | 62. | 504. | 112. |
| 1990 | 38. | 38. | 51. | 43. | 62. | 492. | 111. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 109. | 66. | 25. | 374. | 1017. | 22403. | 143966. |
| 1963 | 139. | 93. | 33. | 368. | 1257. | 19790. | 140587. |
| 1964 | 157. | 102. | 38. | 371. | 1381. | 20961. | 150292. |
| 1965 | 170. | 108. | 40. | 373. | 1364. | 21571. | 187106. |
| 1966 | 152. | 97. | 35. | 377. | 1581. | 20798. | 202731. |
| 1967 | 112. | 73. | 24. | 378. | 999. | 17806. | 91594. |
| 1968 | 140. | 90. | 32. | 381. | 1260. | 19331. | 127766. |
| 1969 | 145. | 92. | 31. | 384. | 1302. | 19498. | 130853. |
| 1970 | 152. | 95. | 33. | 385. | 1342. | 19665. | 132482. |
| 1971 | 156. | 98. | 35. | 388. | 1385. | 19830. | 126803. |
| 1972 | 136. | 100. | 34. | 390. | 1237. | 19573. | 161344. |
| 1973 | 141. | 103. | 36. | 390. | 1267. | 19708. | 164868. |
| 1974 | 144. | 106. | 37. | 393. | 1298. | 19844. | 166849. |
| 1975 | 148. | 109. | 39. | 393. | 1328. | 19977. | 169883. |
| 1976 | 152. | 112. | 40. | 394. | 1358. | 20113. | 171913. |
| 1977 | 156. | 115. | 42. | 395. | 1388. | 20247. | 174470. |
| 1978 | 159. | 117. | 42. | 395. | 1418. | 20383. | 176933. |
| 1979 | 162. | 121. | 45. | 395. | 1447. | 20517. | 179396. |
| 1980 | 167. | 122. | 45. | 396. | 1476. | 20654. | 181849. |
| 1981 | 154. | 111. | 44. | 331. | 1389. | 19854. | 183660. |
| 1982 | 157. | 113. | 44. | 328. | 1414. | 19943. | 186203. |
| 1983 | 160. | 114. | 46. | 326. | 1435. | 20032. | 188828. |
| 1984 | 163. | 116. | 48. | 321. | 1458. | 20115. | 191374. |
| 1985 | 165. | 118. | 48. | 319. | 1481. | 20199. | 193990. |
| 1986 | 168. | 120. | 49. | 316. | 1504. | 20279. | 196725. |
| 1987 | 170. | 120. | 51. | 313. | 1527. | 20357. | 199320. |
| 1988 | 173. | 123. | 51. | 310. | 1551. | 20437. | 201942. |
| 1989 | 175. | 125. | 53. | 307. | 1575. | 20514. | 204656. |
| 1990 | 177. | 125. | 53. | 304. | 1598. | 20589. | 207372. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 176. | 600. | 376. | -21. | 112. | 206. | 202. | 3. |
| 1963 | 291. | 682. | 405. | -14. | 50. | 242. | 158. | 13. |
| 1964 | 312. | 739. | 449. | 19. | 125. | 298. | 259. | 41. |
| 1965 | 328. | 766. | 483. | 38. | 82. | 323. | 226. | 61. |
| 1966 | 409. | 729. | 455. | -6. | 113. | 271. | 209. | 12. |
| 1967 | 248. | 252. | 177. | 68. | 36. | 110. | 156. | 105. |
| 1968 | 284. | 438. | 341. | 21. | 98. | 216. | 215. | 52. |
| 1969 | 289. | 455. | 354. | 20. | 102. | 223. | 224. | 54. |
| 1970 | 294. | 474. | 367. | 20. | 105. | 232. | 232. | 56. |
| 1971 | 299. | 492. | 380. | 18. | 110. | 239. | 241. | 58. |
| 1972 | 367. | 579. | 405. | 50. | 132. | 248. | 251. | 58. |
| 1973 | 376. | 602. | 421. | 49. | 140. | 257. | 259. | 61. |
| 1974 | 386. | 626. | 435. | 50. | 145. | 266. | 270. | 63. |
| 1975 | 398. | 648. | 450. | 51. | 153. | 274. | 279. | 64. |
| 1976 | 407. | 673. | 467. | 52. | 159. | 284. | 290. | 66. |
| 1977 | 419. | 697. | 481. | 52. | 165. | 293. | 299. | 68. |
| 1978 | 429. | 721. | 496. | 52. | 172. | 302. | 310. | 69. |
| 1979 | 439. | 745. | 512. | 53. | 179. | 312. | 319. | 72. |
| 1980 | 449. | 770. | 528. | 54. | 186. | 321. | 331. | 74. |
| 1981 | 404. | 780. | 530. | 49. | 185. | 316. | 315. | 66. |
| 1982 | 411. | 804. | 545. | 50. | 192. | 324. | 325. | 67. |
| 1983 | 418. | 827. | 559. | 51. | 198. | 332. | 334. | 69. |
| 1984 | 423. | 850. | 573. | 50. | 205. | 342. | 343. | 69. |
| 1985 | 430. | 874. | 587. | 50. | 212. | 349. | 352. | 70. |
| 1986 | 434. | 898. | 600. | 51. | 218. | 358. | 361. | 72. |
| 1987 | 440. | 922. | 615. | 51. | 224. | 366. | 371. | 73. |
| 1988 | 445. | 947. | 629. | 51. | 231. | 375. | 382. | 73. |
| 1989 | 449. | 972. | 642. | 51. | 237. | 384. | 390. | 75. |
| 1990 | 454. | 998. | 658. | 51. | 245. | 391. | 401. | 75. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT
--------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 35. | 63. | 50. | 1002. | 20. |
| 1963 | 30. | 26. | 49. | 3. | 47. | 698. | 98. |
| 1964 | 32. | 30. | 47. | 18. | 54. | 693. | 100. |
| 1965 | 33. | 33. | 33. | 73. | 59. | 692. | 102. |
| 1966 | 35. | 29. | 55. | 134. | 73. | 682. | 106. |
| 1967 | 29. | 38. | 41. | -32. | 45. | 680. | 99. |
| 1968 | 33. | 35. | 50. | 45. | 60. | 674. | 102. |
| 1969 | 35. | 36. | 52. | 46. | 62. | 670. | 103. |
| 1970 | 36. | 38. | 52. | 48. | 63. | 665. | 103. |
| 1971 | 36. | 39. | 54. | 51. | 64. | 662. | 103. |
| 1972 | 38. | 40. | 56. | 37. | 67. | 657. | 107. |
| 1973 | 40. | 41. | 57. | 39. | 67. | 654. | 109. |
| 1974 | 41. | 42. | 59. | 41. | 69. | 650. | 109. |
| 1975 | 43. | 44. | 59. | 42. | 72. | 646. | 111. |
| 1976 | 43. | 45. | 62. | 43. | 72. | 641. | 112. |
| 1977 | 45. | 47. | 63. | 45. | 73. | 637. | 113. |
| 1978 | 46. | 47. | 65. | 46. | 76. | 632. | 114. |
| 1979 | 48. | 49. | 65. | 47. | 77. | 625. | 115. |
| 1980 | 48. | 49. | 67. | 48. | 78. | 618. | 116. |
| 1981 | 37. | 36. | 52. | 43. | 60. | 597. | 112. |
| 1982 | 37. | 36. | 52. | 44. | 61. | 587. | 112. |
| 1983 | 38. | 37. | 52. | 44. | 61. | 578. | 112. |
| 1984 | 38. | 37. | 53. | 44. | 61. | 568. | 113. |
| 1985 | 39. | 37. | 53. | 45. | 61. | 556. | 112. |
| 1986 | 39. | 37. | 54. | 45. | 62. | 545. | 113. |
| 1987 | 39. | 37. | 53. | 44. | 63. | 532. | 113. |
| 1988 | 40. | 38. | 54. | 44. | 62. | 521. | 113. |
| 1989 | 40. | 37. | 55. | 45. | 63. | 507. | 112. |
| 1990 | 40. | 38. | 53. | 44. | 63. | 494. | 112. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

--------

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 132. | 80. | 33. | 374. | 1059. | 22245. | 143703. |
| 1963 | 173. | 109. | 44. | 369. | 1344. | 19657. | 140197. |
| 1964 | 168. | 102. | 38. | 372. | 1442. | 21011. | 152984. |
| 1965 | 201. | 120. | 49. | 373. | 1402. | 21302. | 186887. |
| 1966 | 166. | 97. | 34. | 377. | 1725. | 21377. | 205871. |
| 1967 | 123. | 84. | 29. | 377. | 982. | 17363. | 91384. |
| 1968 | 152. | 95. | 35. | 382. | 1305. | 19436. | 131504. |
| 1969 | 158. | 99. | 35. | 384. | 1349. | 19622. | 134581. |
| 1970 | 164. | 102. | 37. | 386. | 1395. | 19808. | 136178. |
| 1971 | 170. | 105. | 38. | 387. | 1443. | 19995. | 130448. |
| 1972 | 149. | 109. | 39. | 390. | 1301. | 20036. | 165481. |
| 1973 | 154. | 111. | 40. | 391. | 1336. | 20208. | 169299. |
| 1974 | 157. | 115. | 42. | 393. | 1372. | 20383. | 171596. |
| 1975 | 162. | 118. | 43. | 393. | 1407. | 20556. | 174965. |
| 1976 | 167. | 122. | 46. | 394. | 1441. | 20733. | 177355. |
| 1977 | 171. | 125. | 47. | 396. | 1478. | 20912. | 180293. |
| 1978 | 176. | 128. | 48. | 395. | 1512. | 21094. | 183161. |
| 1979 | 181. | 132. | 50. | 396. | 1548. | 21277. | 186056. |
| 1980 | 185. | 136. | 52. | 395. | 1584. | 21466. | 188967. |
| 1981 | 174. | 124. | 51. | 332. | 1504. | 20719. | 191263. |
| 1982 | 178. | 126. | 52. | 329. | 1534. | 20864. | 194322. |
| 1983 | 183. | 129. | 53. | 325. | 1564. | 21012. | 197492. |
| 1984 | 185. | 132. | 56. | 322. | 1596. | 21158. | 200614. |
| 1985 | 189. | 134. | 56. | 320. | 1626. | 21306. | 203841. |
| 1986 | 194. | 137. | 58. | 316. | 1658. | 21454. | 207220. |
| 1987 | 198. | 139. | 60. | 313. | 1689. | 21603. | 210497. |
| 1988 | 202. | 141. | 62. | 311. | 1723. | 21759. | 213840. |
| 1989 | 206. | 144. | 63. | 307. | 1756. | 21914. | 217312. |
| 1990 | 211. | 146. | 64. | 305. | 1792. | 22073. | 220831. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 176. | 511. | 335. | -21. | 141. | 188. | 228. | 4. |
| 1963 | 297. | 512. | 347. | -11. | 136. | 218. | 226. | 14. |
| 1964 | 306. | 621. | 396. | 17. | 167. | 256. | 278. | 42. |
| 1965 | 344. | 670. | 420. | 34. | 182. | 278. | 302. | 61. |
| 1966 | 401. | 528. | 367. | -8. | 140. | 233. | 231. | 13. |
| 1967 | 268. | 237. | 236. | 62. | 65. | 154. | 154. | 105. |
| 1968 | 292. | 432. | 331. | 17. | 120. | 209. | 216. | 52. |
| 1969 | 297. | 448. | 343. | 17. | 127. | 217. | 225. | 54. |
| 1970 | 303. | 464. | 355. | 15. | 131. | 224. | 232. | 56. |
| 1971 | 309. | 482. | 367. | 14. | 138. | 232. | 243. | 58. |
| 1972 | 371. | 555. | 387. | 48. | 140. | 240. | 251. | 58. |
| 1973 | 382. | 579. | 401. | 50. | 147. | 249. | 260. | 61. |
| 1974 | 392. | 600. | 416. | 49. | 153. | 257. | 270. | 63. |
| 1975 | 403. | 623. | 429. | 51. | 159. | 265. | 280. | 65. |
| 1976 | 413. | 645. | 443. | 51. | 166. | 274. | 290. | 66. |
| 1977 | 425. | 669. | 458. | 51. | 173. | 282. | 300. | 67. |
| 1978 | 435. | 691. | 473. | 52. | 181. | 292. | 309. | 70. |
| 1979 | 446. | 714. | 486. | 52. | 187. | 299. | 321. | 72. |
| 1980 | 457. | 737. | 499. | 53. | 195. | 309. | 331. | 73. |
| 1981 | 412. | 746. | 502. | 49. | 194. | 303. | 316. | 67. |
| 1982 | 419. | 767. | 515. | 49. | 201. | 310. | 325. | 67. |
| 1983 | 426. | 789. | 527. | 50. | 208. | 319. | 334. | 69. |
| 1984 | 433. | 811. | 539. | 50. | 215. | 325. | 344. | 69. |
| 1985 | 439. | 833. | 552. | 49. | 222. | 334. | 353. | 70. |
| 1986 | 445. | 855. | 564. | 50. | 229. | 342. | 362. | 72. |
| 1987 | 451. | 876. | 576. | 51. | 235. | 348. | 371. | 73. |
| 1988 | 455. | 899. | 588. | 49. | 243. | 357. | 382. | 74. |
| 1989 | 460. | 922. | 601. | 51. | 250. | 364. | 390. | 75. |
| 1990 | 466. | 946. | 614. | 50. | 257. | 373. | 400. | 75. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT
--------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 36. | 63. | 52. | 1001. | 19. |
| 1963 | 29. | 27. | 50. | 3. | 50. | 697. | 98. |
| 1964 | 31. | 29. | 49. | 19. | 54. | 694. | 98. |
| 1965 | 33. | 33. | 35. | 73. | 65. | 691. | 100. |
| 1966 | 33. | 30. | 56. | 133. | 74. | 682. | 104. |
| 1967 | 30. | 38. | 39. | -31. | 45. | 678. | 100. |
| 1968 | 33. | 35. | 51. | 44. | 60. | 674. | 101. |
| 1969 | 34. | 35. | 51. | 46. | 63. | 670. | 101. |
| 1970 | 36. | 38. | 53. | 48. | 63. | 665. | 102. |
| 1971 | 36. | 39. | 53. | 51. | 65. | 661. | 102. |
| 1972 | 38. | 40. | 56. | 37. | 67. | 657. | 107. |
| 1973 | 39. | 41. | 57. | 38. | 68. | 653. | 108. |
| 1974 | 41. | 43. | 56. | 41. | 70. | 650. | 110. |
| 1975 | 42. | 44. | 60. | 42. | 71. | 646. | 110. |
| 1976 | 43. | 45. | 61. | 43. | 73. | 640. | 112. |
| 1977 | 45. | 46. | 63. | 45. | 74. | 637. | 112. |
| 1978 | 45. | 48. | 64. | 45. | 76. | 631. | 114. |
| 1979 | 47. | 49. | 65. | 47. | 78. | 624. | 115. |
| 1980 | 48. | 49. | 66. | 48. | 79. | 618. | 115. |
| 1981 | 37. | 36. | 52. | 43. | 60. | 596. | 111. |
| 1982 | 36. | 36. | 51. | 43. | 61. | 587. | 112. |
| 1983 | 38. | 37. | 52. | 44. | 62. | 577. | 112. |
| 1984 | 38. | 37. | 53. | 44. | 62. | 567. | 112. |
| 1985 | 38. | 37. | 52. | 45. | 62. | 556. | 112. |
| 1986 | 38. | 37. | 53. | 44. | 62. | 544. | 112. |
| 1987 | 39. | 38. | 53. | 44. | 63. | 531. | 112. |
| 1988 | 38. | 37. | 53. | 44. | 63. | 520. | 113. |
| 1989 | 40. | 38. | 54. | 45. | 64. | 506. | 111. |
| 1990 | 39. | 37. | 52. | 44. | 64. | 493. | 112. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 109. | 66. | 25. | 374. | 1017. | 22403. | 143966. |
| 1963 | 139. | 93. | 33. | 368. | 1257. | 19790. | 140587. |
| 1964 | 157. | 102. | 38. | 371. | 1381. | 20961. | 150292. |
| 1965 | 170. | 108. | 40. | 373. | 1364. | 21571. | 187106. |
| 1966 | 152. | 97. | 35. | 377. | 1581. | 20798. | 202731. |
| 1967 | 112. | 73. | 24. | 378. | 999. | 17806. | 91594. |
| 1968 | 145. | 92. | 33. | 381. | 1298. | 19637. | 131959. |
| 1969 | 151. | 96. | 33. | 384. | 1342. | 19835. | 135185. |
| 1970 | 158. | 98. | 34. | 386. | 1389. | 20030. | 136949. |
| 1971 | 163. | 101. | 36. | 388. | 1435. | 20227. | 131404. |
| 1972 | 143. | 104. | 36. | 390. | 1289. | 19989. | 166577. |
| 1973 | 149. | 107. | 38. | 391. | 1323. | 20156. | 170473. |
| 1974 | 153. | 110. | 39. | 393. | 1357. | 20322. | 172847. |
| 1975 | 157. | 114. | 40. | 393. | 1392. | 20490. | 176295. |
| 1976 | 161. | 116. | 42. | 394. | 1427. | 20658. | 178761. |
| 1977 | 166. | 120. | 44. | 396. | 1461. | 20831. | 181779. |
| 1978 | 170. | 123. | 45. | 395. | 1495. | 21004. | 184727. |
| 1979 | 174. | 126. | 47. | 396. | 1530. | 21180. | 187703. |
| 1980 | 179. | 129. | 48. | 395. | 1564. | 21360. | 190696. |
| 1981 | 167. | 117. | 46. | 332. | 1484. | 20605. | 193076. |
| 1982 | 171. | 120. | 48. | 329. | 1512. | 20742. | 196218. |
| 1983 | 175. | 122. | 49. | 326. | 1542. | 20881. | 199474. |
| 1984 | 178. | 124. | 51. | 322. | 1571. | 21018. | 202685. |
| 1985 | 182. | 126. | 52. | 319. | 1601. | 21158. | 206004. |
| 1986 | 185. | 128. | 53. | 316. | 1632. | 21296. | 209477. |
| 1987 | 188. | 131. | 54. | 314. | 1662. | 21436. | 212850. |
| 1988 | 193. | 133. | 56. | 310. | 1693. | 21582. | 216293. |
| 1989 | 196. | 135. | 57. | 308. | 1726. | 21728. | 219868. |
| 1990 | 200. | 137. | 58. | 305. | 1759. | 21875. | 223494. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

--------

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 176. | 600. | 376. | -21. | 112. | 206. | 202. | 3. |
| 1963 | 291. | 682. | 405. | -14. | 50. | 242. | 158. | 13. |
| 1964 | 312. | 739. | 449. | 19. | 125. | 298. | 259. | 41. |
| 1965 | 328. | 766. | 483. | 38. | 82. | 323. | 226. | 61. |
| 1966 | 409. | 729. | 455. | -6. | 113. | 271. | 209. | 12. |
| 1967 | 248. | 252. | 177. | 68. | 36. | 110. | 156. | 105. |
| 1968 | 288. | 477. | 358. | 21. | 106. | 228. | 226. | 52. |
| 1969 | 293. | 499. | 372. | 21. | 111. | 237. | 236. | 55. |
| 1970 | 299. | 520. | 386. | 19. | 115. | 245. | 245. | 56. |
| 1971 | 304. | 542. | 402. | 19. | 120. | 255. | 255. | 57. |
| 1972 | 372. | 633. | 429. | 50. | 144. | 266. | 266. | 59. |
| 1973 | 382. | 660. | 446. | 50. | 152. | 276. | 277. | 61. |
| 1974 | 392. | 688. | 462. | 50. | 159. | 286. | 287. | 63. |
| 1975 | 404. | 717. | 481. | 52. | 166. | 296. | 299. | 65. |
| 1976 | 414. | 746. | 499. | 52. | 175. | 307. | 310. | 67. |
| 1977 | 426. | 774. | 518. | 52. | 182. | 318. | 322. | 68. |
| 1978 | 437. | 804. | 534. | 53. | 190. | 329. | 333. | 69. |
| 1979 | 448. | 835. | 554. | 53. | 199. | 341. | 345. | 73. |
| 1980 | 459. | 865. | 572. | 55. | 206. | 352. | 358. | 74. |
| 1981 | 414. | 883. | 579. | 51. | 208. | 350. | 346. | 67. |
| 1982 | 421. | 913. | 596. | 50. | 215. | 362. | 356. | 67. |
| 1983 | 428. | 944. | 615. | 51. | 225. | 372. | 368. | 69. |
| 1984 | 435. | 976. | 633. | 52. | 232. | 383. | 379. | 70. |
| 1985 | 442. | 1007. | 651. | 50. | 241. | 395. | 391. | 71. |
| 1986 | 449. | 1041. | 670. | 52. | 249. | 406. | 403. | 73. |
| 1987 | 453. | 1074. | 688. | 52. | 258. | 418. | 416. | 73. |
| 1988 | 460. | 1109. | 708. | 51. | 267. | 430. | 427. | 75. |
| 1989 | 465. | 1146. | 727. | 52. | 276. | 442. | 440. | 75. |
| 1990 | 471. | 1182. | 748. | 53. | 284. | 455. | 454. | 76. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT
--------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 35. | 63. | 50. | 1002. | 20. |
| 1963 | 30. | 26. | 49. | 3. | 47. | 698. | 98. |
| 1964 | 32. | 30. | 47. | 18. | 54. | 693. | 100. |
| 1965 | 33. | 33. | 33. | 73. | 59. | 692. | 102. |
| 1966 | 35. | 29. | 55. | 134. | 73. | 682. | 106. |
| 1967 | 29. | 38. | 41. | -32. | 45. | 680. | 99. |
| 1968 | 34. | 35. | 50. | 45. | 60. | 674. | 102. |
| 1969 | 35. | 36. | 52. | 46. | 62. | 670. | 103. |
| 1970 | 36. | 38. | 53. | 48. | 64. | 666. | 103. |
| 1971 | 38. | 39. | 54. | 51. | 64. | 662. | 104. |
| 1972 | 38. | 40. | 56. | 38. | 67. | 658. | 107. |
| 1973 | 41. | 41. | 57. | 38. | 68. | 654. | 109. |
| 1974 | 42. | 43. | 59. | 41. | 69. | 651. | 110. |
| 1975 | 43. | 44. | 60. | 43. | 72. | 646. | 111. |
| 1976 | 45. | 45. | 62. | 43. | 73. | 642. | 112. |
| 1977 | 46. | 47. | 63. | 45. | 74. | 637. | 113. |
| 1978 | 47. | 47. | 65. | 46. | 76. | 633. | 114. |
| 1979 | 48. | 49. | 66. | 47. | 77. | 625. | 116. |
| 1980 | 50. | 50. | 67. | 48. | 79. | 619. | 116. |
| 1981 | 38. | 36. | 52. | 43. | 60. | 598. | 112. |
| 1982 | 39. | 36. | 52. | 44. | 62. | 588. | 112. |
| 1983 | 39. | 37. | 53. | 44. | 61. | 579. | 113. |
| 1984 | 40. | 37. | 53. | 45. | 62. | 568. | 113. |
| 1985 | 41. | 38. | 54. | 45. | 63. | 558. | 113. |
| 1986 | 41. | 37. | 54. | 45. | 62. | 546. | 112. |
| 1987 | 41. | 38. | 54. | 44. | 64. | 533. | 114. |
| 1988 | 42. | 38. | 55. | 45. | 63. | 522. | 113. |
| 1989 | 42. | 37. | 54. | 45. | 64. | 508. | 112. |
| 1990 | 42. | 39. | 55. | 45. | 64. | 496. | 112. |

Table I-22

# PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

--------

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 132. | 80. | 33. | 374. | 1059. | 22245. | 143703. |
| 1963 | 173. | 109. | 44. | 369. | 1344. | 19657. | 140197. |
| 1964 | 168. | 102. | 38. | 372. | 1442. | 21011. | 152984. |
| 1965 | 201. | 120. | 49. | 373. | 1402. | 21302. | 186887. |
| 1966 | 166. | 97. | 34. | 377. | 1725. | 21377. | 205871. |
| 1967 | 123. | 84. | 29. | 377. | 982. | 17363. | 91384. |
| 1968 | 158. | 99. | 36. | 382. | 1345. | 19750. | 135832. |
| 1969 | 165. | 102. | 37. | 384. | 1394. | 19970. | 139099. |
| 1970 | 172. | 105. | 39. | 386. | 1446. | 20191. | 140879. |
| 1971 | 179. | 110. | 40. | 388. | 1499. | 20418. | 135326. |
| 1972 | 158. | 112. | 40. | 390. | 1360. | 20486. | 171019. |
| 1973 | 164. | 116. | 43. | 391. | 1400. | 20698. | 175251. |
| 1974 | 168. | 120. | 44. | 394. | 1440. | 20912. | 177983. |
| 1975 | 173. | 124. | 47. | 393. | 1480. | 21129. | 181814. |
| 1976 | 179. | 128. | 48. | 395. | 1522. | 21353. | 184688. |
| 1977 | 184. | 131. | 50. | 395. | 1564. | 21579. | 188140. |
| 1978 | 189. | 135. | 52. | 396. | 1606. | 21814. | 191553. |
| 1979 | 196. | 139. | 54. | 396. | 1648. | 22053. | 195026. |
| 1980 | 201. | 143. | 56. | 396. | 1691. | 22300. | 198547. |
| 1981 | 191. | 133. | 55. | 332. | 1619. | 21615. | 201496. |
| 1982 | 196. | 135. | 56. | 329. | 1658. | 21828. | 205243. |
| 1983 | 201. | 139. | 59. | 327. | 1697. | 22044. | 209145. |
| 1984 | 205. | 141. | 60. | 322. | 1737. | 22267. | 213046. |
| 1985 | 212. | 145. | 63. | 320. | 1778. | 22493. | 217098. |
| 1986 | 216. | 148. | 65. | 317. | 1820. | 22726. | 221355. |
| 1987 | 222. | 151. | 66. | 314. | 1863. | 22963. | 225564. |
| 1988 | 228. | 154. | 69. | 312. | 1908. | 23212. | 229894. |
| 1989 | 233. | 157. | 70. | 308. | 1955. | 23468. | 234414. |
| 1990 | 240. | 162. | 73. | 306. | 2004. | 23732. | 239046. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 176. | 511. | 335. | -21. | 141. | 188. | 228. | 4. |
| 1963 | 297. | 512. | 347. | -11. | 136. | 218. | 226. | 14. |
| 1964 | 306. | 621. | 396. | 17. | 167. | 256. | 278. | 42. |
| 1965 | 344. | 670. | 420. | 34. | 182. | 278. | 302. | 61. |
| 1966 | 401. | 528. | 367. | -8. | 140. | 233. | 231. | 13. |
| 1967 | 268. | 237. | 236. | 62. | 65. | 154. | 154. | 105. |
| 1968 | 296. | 465. | 346. | 17. | 130. | 220. | 229. | 52. |
| 1969 | 301. | 483. | 358. | 17. | 136. | 227. | 238. | 54. |
| 1970 | 308. | 501. | 372. | 15. | 142. | 236. | 248. | 57. |
| 1971 | 313. | 522. | 386. | 14. | 150. | 245. | 258. | 57. |
| 1972 | 377. | 600. | 407. | 49. | 153. | 254. | 269. | 60. |
| 1973 | 387. | 625. | 422. | 49. | 161. | 264. | 279. | 60. |
| 1974 | 398. | 652. | 438. | 50. | 167. | 273. | 291. | 64. |
| 1975 | 410. | 679. | 455. | 51. | 175. | 283. | 302. | 64. |
| 1976 | 420. | 705. | 470. | 51. | 184. | 292. | 314. | 67. |
| 1977 | 433. | 732. | 486. | 52. | 191. | 303. | 324. | 68. |
| 1978 | 443. | 760. | 504. | 52. | 201. | 313. | 338. | 70. |
| 1979 | 455. | 788. | 519. | 52. | 208. | 322. | 350. | 72. |
| 1980 | 467. | 816. | 536. | 54. | 218. | 334. | 363. | 74. |
| 1981 | 422. | 830. | 540. | 49. | 218. | 329. | 349. | 67. |
| 1982 | 429. | 859. | 555. | 50. | 228. | 339. | 361. | 67. |
| 1983 | 438. | 886. | 571. | 50. | 236. | 349. | 372. | 70. |
| 1984 | 445. | 915. | 587. | 50. | 245. | 360. | 385. | 70. |
| 1985 | 453. | 943. | 603. | 50. | 253. | 368. | 396. | 71. |
| 1986 | 459. | 974. | 617. | 51. | 263. | 379. | 409. | 72. |
| 1987 | 466. | 1003. | 634. | 51. | 272. | 389. | 421. | 74. |
| 1988 | 471. | 1035. | 650. | 50. | 282. | 399. | 434. | 74. |
| 1989 | 478. | 1067. | 665. | 51. | 292. | 411. | 448. | 76. |
| 1990 | 483. | 1100. | 684. | 50. | 301. | 420. | 461. | 76. |

Table I-22

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

--------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI- NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 25. | 17. | 36. | 63. | 52. | 1001. | 19. |
| 1963 | 29. | 27. | 50. | 3. | 50. | 697. | 98. |
| 1964 | 31. | 29. | 49. | 19. | 54. | 694. | 98. |
| 1965 | 33. | 33. | 35. | 73. | 65. | 691. | 100. |
| 1966 | 33. | 30. | 56. | 133. | 74. | 682. | 104. |
| 1967 | 30. | 38. | 39. | -31. | 45. | 678. | 100. |
| 1968 | 33. | 35. | 51. | 44. | 61. | 674. | 101. |
| 1969 | 35. | 36. | 52. | 46. | 63. | 671. | 102. |
| 1970 | 36. | 38. | 53. | 48. | 64. | 665. | 101. |
| 1971 | 37. | 39. | 54. | 51. | 65. | 662. | 103. |
| 1972 | 38. | 40. | 56. | 37. | 68. | 657. | 106. |
| 1973 | 40. | 41. | 57. | 39. | 68. | 654. | 108. |
| 1974 | 41. | 42. | 59. | 41. | 71. | 650. | 110. |
| 1975 | 43. | 45. | 60. | 42. | 72. | 647. | 110. |
| 1976 | 44. | 45. | 62. | 43. | 73. | 641. | 112. |
| 1977 | 45. | 47. | 64. | 45. | 75. | 637. | 113. |
| 1978 | 47. | 47. | 64. | 45. | 77. | 632. | 113. |
| 1979 | 47. | 49. | 66. | 47. | 79. | 625. | 115. |
| 1980 | 49. | 50. | 67. | 49. | 80. | 619. | 116. |
| 1981 | 38. | 36. | 53. | 42. | 61. | 597. | 111. |
| 1982 | 37. | 36. | 52. | 44. | 62. | 588. | 112. |
| 1983 | 39. | 37. | 53. | 44. | 63. | 578. | 112. |
| 1984 | 39. | 37. | 53. | 44. | 63. | 568. | 112. |
| 1985 | 39. | 38. | 54. | 45. | 64. | 557. | 112. |
| 1986 | 40. | 37. | 54. | 45. | 64. | 545. | 112. |
| 1987 | 40. | 38. | 54. | 44. | 65. | 533. | 113. |
| 1988 | 41. | 38. | 55. | 44. | 65. | 521. | 112. |
| 1989 | 40. | 38. | 55. | 45. | 65. | 508. | 112. |
| 1990 | 42. | 38. | 54. | 44. | 66. | 495. | 111. |

Table I-22

(Page 35 of 72)
Projection 12-A

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: 100. PERCENT

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1962 | 109. | 66. | 25. | 374. | 1017. | 22403. | 143966. |
| 1963 | 139. | 93. | 33. | 368. | 1257. | 19790. | 140587. |
| 1964 | 157. | 102. | 38. | 371. | 1381. | 20961. | 150292. |
| 1965 | 170. | 108. | 40. | 373. | 1364. | 21571. | 187106. |
| 1966 | 152. | 97. | 35. | 377. | 1581. | 20798. | 202731. |
| 1967 | 112. | 73. | 24. | 378. | 999. | 17806. | 91594. |
| 1968 | 151. | 95. | 34. | 381. | 1335. | 19944. | 136152. |
| 1969 | 156. | 98. | 34. | 384. | 1384. | 20172. | 139558. |
| 1970 | 164. | 102. | 36. | 386. | 1435. | 20402. | 141501. |
| 1971 | 171. | 104. | 37. | 388. | 1487. | 20635. | 136133. |
| 1972 | 151. | 108. | 38. | 391. | 1343. | 20423. | 171998. |
| 1973 | 156. | 111. | 39. | 391. | 1382. | 20622. | 176326. |
| 1974 | 162. | 115. | 41. | 393. | 1421. | 20827. | 179161. |
| 1975 | 166. | 118. | 43. | 394. | 1461. | 21032. | 183095. |
| 1976 | 171. | 122. | 44. | 395. | 1499. | 21243. | 186081. |
| 1977 | 177. | 125. | 46. | 395. | 1539. | 21459. | 189650. |
| 1978 | 182. | 129. | 48. | 396. | 1580. | 21679. | 193180. |
| 1979 | 187. | 133. | 49. | 396. | 1619. | 21905. | 196776. |
| 1980 | 192. | 136. | 52. | 396. | 1662. | 22136. | 200426. |
| 1981 | 181. | 126. | 49. | 332. | 1587. | 21437. | 203503. |
| 1982 | 187. | 127. | 50. | 330. | 1624. | 21633. | 207385. |
| 1983 | 191. | 130. | 53. | 326. | 1661. | 21834. | 211425. |
| 1984 | 196. | 134. | 55. | 323. | 1699. | 22038. | 215467. |
| 1985 | 201. | 136. | 56. | 320. | 1737. | 22247. | 219665. |
| 1986 | 205. | 138. | 57. | 317. | 1777. | 22461. | 224072. |
| 1987 | 210. | 142. | 59. | 314. | 1817. | 22679. | 228434. |
| 1988 | 215. | 144. | 61. | 311. | 1860. | 22910. | 232924. |
| 1989 | 220. | 147. | 62. | 309. | 1902. | 23143. | 237608. |
| 1990 | 226. | 150. | 64. | 305. | 1949. | 23385. | 242409. |

Table I-22

(Page 36 of 72)
Projection 12-A

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
--------

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 211. | 638. | 383. | 2. | 123. | 206. | 202. | 3. |
| 1963 | 540. | 1360. | 794. | 9. | 185. | 448. | 360. | 16. |
| 1964 | 893. | 2162. | 1250. | 52. | 326. | 745. | 618. | 57. |
| 1965 | 1274. | 2967. | 1741. | 118. | 425. | 1067. | 843. | 118. |
| 1966 | 1767. | 3819. | 2211. | 129. | 559. | 1337. | 1052. | 130. |
| 1967 | 2072. | 4119. | 2397. | 244. | 609. | 1446. | 1207. | 235. |
| 1968 | 2415. | 4581. | 2731. | 298. | 719. | 1648. | 1410. | 287. |
| 1969 | 2766. | 5061. | 3076. | 352. | 833. | 1857. | 1620. | 341. |
| 1970 | 3125. | 5558. | 3432. | 408. | 951. | 2073. | 1837. | 396. |
| 1971 | 3495. | 6075. | 3800. | 465. | 1076. | 2295. | 2063. | 453. |
| 1972 | 3873. | 6610. | 4182. | 524. | 1206. | 2525. | 2295. | 510. |
| 1973 | 4261. | 7165. | 4575. | 583. | 1340. | 2761. | 2537. | 570. |
| 1974 | 4660. | 7740. | 4981. | 643. | 1480. | 3005. | 2786. | 632. |
| 1975 | 5068. | 8335. | 5400. | 704. | 1626. | 3257. | 3044. | 696. |
| 1976 | 5487. | 8948. | 5833. | 767. | 1778. | 3517. | 3310. | 761. |
| 1977 | 5918. | 9582. | 6278. | 830. | 1935. | 3783. | 3585. | 828. |
| 1978 | 6357. | 10234. | 6734. | 893. | 2098. | 4056. | 3867. | 896. |
| 1979 | 6808. | 10905. | 7204. | 958. | 2268. | 4336. | 4158. | 967. |
| 1980 | 7268. | 11595. | 7685. | 1022. | 2442. | 4623. | 4457. | 1038. |
| 1981 | 7682. | 12289. | 8166. | 1084. | 2615. | 4904. | 4740. | 1103. |
| 1982 | 8103. | 13001. | 8658. | 1147. | 2793. | 5190. | 5029. | 1168. |
| 1983 | 8531. | 13729. | 9159. | 1210. | 2977. | 5483. | 5324. | 1234. |
| 1984 | 8963. | 14473. | 9669. | 1273. | 3166. | 5779. | 5627. | 1302. |
| 1985 | 9402. | 15232. | 10191. | 1336. | 3359. | 6082. | 5935. | 1370. |
| 1986 | 9844. | 16007. | 10719. | 1402. | 3557. | 6390. | 6251. | 1439. |
| 1987 | 10291. | 16796. | 11257. | 1466. | 3760. | 6702. | 6572. | 1508. |
| 1988 | 10741. | 17601. | 11803. | 1531. | 3967. | 7019. | 6899. | 1579. |
| 1989 | 11194. | 18420. | 12357. | 1597. | 4180. | 7341. | 7232. | 1650. |
| 1990 | 11651. | 19254. | 12919. | 1663. | 4397. | 7667. | 7570. | 1720. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
---------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 35. | 50. | 50. | 1002. | 21. |
| 1963 | 55. | 44. | 84. | 40. | 97. | 1699. | 121. |
| 1964 | 87. | 74. | 131. | 47. | 151. | 2390. | 222. |
| 1965 | 120. | 107. | 164. | 104. | 210. | 3078. | 326. |
| 1966 | 155. | 135. | 219. | 213. | 283. | 3757. | 435. |
| 1967 | 184. | 173. | 259. | 174. | 328. | 4433. | 535. |
| 1968 | 217. | 208. | 309. | 203. | 387. | 5102. | 638. |
| 1969 | 250. | 244. | 359. | 233. | 448. | 5766. | 742. |
| 1970 | 285. | 282. | 412. | 265. | 510. | 6424. | 848. |
| 1971 | 321. | 319. | 466. | 298. | 574. | 7079. | 954. |
| 1972 | 359. | 359. | 520. | 333. | 639. | 7729. | 1060. |
| 1973 | 397. | 400. | 577. | 368. | 707. | 8374. | 1167. |
| 1974 | 437. | 442. | 635. | 407. | 774. | 9016. | 1277. |
| 1975 | 479. | 485. | 694. | 445. | 844. | 9651. | 1387. |
| 1976 | 521. | 529. | 755. | 485. | 915. | 10281. | 1498. |
| 1977 | 565. | 575. | 816. | 527. | 988. | 10906. | 1610. |
| 1978 | 610. | 622. | 879. | 569. | 1061. | 11524. | 1723. |
| 1979 | 655. | 669. | 943. | 612. | 1137. | 12134. | 1838. |
| 1980 | 703. | 718. | 1009. | 656. | 1213. | 12737. | 1953. |
| 1981 | 737. | 752. | 1058. | 695. | 1270. | 13315. | 2063. |
| 1982 | 773. | 788. | 1109. | 735. | 1328. | 13884. | 2173. |
| 1983 | 808. | 823. | 1159. | 774. | 1387. | 14440. | 2284. |
| 1984 | 844. | 858. | 1211. | 814. | 1445. | 14985. | 2395. |
| 1985 | 880. | 894. | 1261. | 854. | 1504. | 15515. | 2505. |
| 1986 | 917. | 929. | 1312. | 894. | 1562. | 16032. | 2615. |
| 1987 | 952. | 965. | 1363. | 934. | 1621. | 16534. | 2724. |
| 1988 | 989. | 1000. | 1414. | 973. | 1680. | 17020. | 2833. |
| 1989 | 1026. | 1036. | 1464. | 1011. | 1739. | 17490. | 2941. |
| 1990 | 1062. | 1071. | 1515. | 1050. | 1797. | 17943. | 3048. |

Table I-22

(Page 38 of 72)
Projection 1-B

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -C. | -0. | 0. | 0. |
| 1962 | 117. | 80. | 33. | 374. | 948. | 22175. | 162389. |
| 1963 | 270. | 189. | 77. | 743. | 2159. | 41685. | 323281. |
| 1964 | 417. | 291. | 115. | 1113. | 3443. | 62520. | 500050. |
| 1965 | 589. | 410. | 164. | 1485. | 4673. | 83553. | 714810. |
| 1966 | 726. | 506. | 198. | 1861. | 6171. | 104783. | 953278. |
| 1967 | 824. | 590. | 227. | 2236. | 6985. | 121974. | 1070412. |
| 1968 | 940. | 682. | 260. | 2615. | 8047. | 140827. | 1228396. |
| 1969 | 1060. | 777. | 293. | 2996. | 9135. | 159807. | 1391316. |
| 1970 | 1182. | 875. | 328. | 3379. | 10251. | 178911. | 1557806. |
| 1971 | 1308. | 976. | 363. | 3764. | 11394. | 198135. | 1720660. |
| 1972 | 1438. | 1080. | 400. | 4149. | 12566. | 217477. | 1890012. |
| 1973 | 1571. | 1186. | 438. | 4536. | 13764. | 236934. | 2063040. |
| 1974 | 1707. | 1295. | 477. | 4923. | 14991. | 256505. | 2238196. |
| 1975 | 1847. | 1407. | 518. | 5311. | 16243. | 276187. | 2416542. |
| 1976 | 1990. | 1522. | 559. | 5699. | 17523. | 295980. | 2597069. |
| 1977 | 2137. | 1640. | 602. | 6087. | 18829. | 315879. | 2780294. |
| 1978 | 2287. | 1761. | 647. | 6475. | 20159. | 335884. | 2966117. |
| 1979 | 2439. | 1884. | 693. | 6862. | 21514. | 355989. | 3154532. |
| 1980 | 2595. | 2010. | 740. | 7250. | 22895. | 376192. | 3345491. |
| 1981 | 2739. | 2124. | 785. | 7571. | 24183. | 395551. | 3538338. |
| 1982 | 2884. | 2240. | 833. | 7889. | 25489. | 414953. | 3733788. |
| 1983 | 3032. | 2357. | 881. | 8203. | 26811. | 434391. | 3931891. |
| 1984 | 3182. | 2476. | 930. | 8513. | 28151. | 453856. | 4132534. |
| 1985 | 3333. | 2597. | 980. | 8818. | 29506. | 473338. | 4335758. |
| 1986 | 3486. | 2719. | 1031. | 9120. | 30875. | 492828. | 4541636. |
| 1987 | 3641. | 2843. | 1084. | 9417. | 32260. | 512312. | 4749973. |
| 1988 | 3798. | 2968. | 1137. | 9709. | 33659. | 531781. | 4960707. |
| 1989 | 3954. | 3093. | 1192. | 9995. | 35071. | 551221. | 5173873. |
| 1990 | 4114. | 3221. | 1247. | 10277. | 36497. | 570623. | 5389414. |

Table 1-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 208. | 545. | 339. | 5. | 138. | 188. | 228. | 4. |
| 1963 | 539. | 1097. | 689. | 17. | 270. | 406. | 454. | 18. |
| 1964 | 883. | 1762. | 1088. | 62. | 434. | 661. | 731. | 60. |
| 1965 | 1273. | 2485. | 1513. | 129. | 610. | 938. | 1032. | 121. |
| 1966 | 1752. | 3072. | 1888. | 142. | 745. | 1170. | 1262. | 134. |
| 1967 | 2073. | 3357. | 2131. | 255. | 805. | 1323. | 1415. | 239. |
| 1968 | 2419. | 3813. | 2453. | 310. | 911. | 1521. | 1617. | 290. |
| 1969 | 2772. | 4285. | 2786. | 365. | 1021. | 1726. | 1826. | 345. |
| 1970 | 3134. | 4776. | 3129. | 422. | 1136. | 1937. | 2043. | 400. |
| 1971 | 3506. | 5285. | 3484. | 480. | 1255. | 2154. | 2267. | 457. |
| 1972 | 3888. | 5812. | 3851. | 540. | 1381. | 2380. | 2499. | 514. |
| 1973 | 4278. | 6358. | 4230. | 601. | 1511. | 2610. | 2739. | 575. |
| 1974 | 4681. | 6924. | 4620. | 662. | 1645. | 2849. | 2987. | 636. |
| 1975 | 5093. | 7510. | 5024. | 724. | 1787. | 3094. | 3243. | 701. |
| 1976 | 5515. | 8113. | 5440. | 788. | 1933. | 3348. | 3508. | 766. |
| 1977 | 5949. | 8736. | 5867. | 852. | 2085. | 3607. | 3781. | 833. |
| 1978 | 6392. | 9378. | 6306. | 917. | 2242. | 3874. | 4061. | 901. |
| 1979 | 6847. | 10038. | 6758. | 983. | 2406. | 4148. | 4350. | 972. |
| 1980 | 7311. | 10716. | 7219. | 1049. | 2574. | 4428. | 4647. | 1043. |
| 1981 | 7731. | 11398. | 7681. | 1113. | 2740. | 4701. | 4927. | 1108. |
| 1982 | 8156. | 12098. | 8152. | 1177. | 2912. | 4980. | 5213. | 1173. |
| 1983 | 8589. | 12812. | 8632. | 1242. | 3088. | 5264. | 5506. | 1240. |
| 1984 | 9026. | 13543. | 9120. | 1307. | 3270. | 5553. | 5806. | 1308. |
| 1985 | 9470. | 14288. | 9619. | 1372. | 3455. | 5847. | 6111. | 1376. |
| 1986 | 9917. | 15048. | 10124. | 1439. | 3645. | 6146. | 6422. | 1445. |
| 1987 | 10370. | 15822. | 10638. | 1506. | 3840. | 6450. | 6739. | 1514. |
| 1988 | 10826. | 16612. | 11160. | 1573. | 4039. | 6759. | 7062. | 1585. |
| 1989 | 11286. | 17415. | 11688. | 1641. | 4242. | 7071. | 7390. | 1656. |
| 1990 | 11749. | 18233. | 12223. | 1710. | 4450. | 7388. | 7723. | 1727. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PROCUCING ANC OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI- NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 36. | 50. | 52. | 1001. | 21. |
| 1963 | 54. | 45. | 86. | 41. | 102. | 1697. | 120. |
| 1964 | ,85. | 74. | 135. | 48. | 156. | 2389. | 221. |
| 1965 | 118. | 107. | 170. | 105. | 220. | 3076. | 324. |
| 1966 | 151. | 136. | 226. | 214. | 294. | 3755. | 432. |
| 1967 | 181. | 174. | 264. | 175. | 339. | 4430. | 534. |
| 1968 | 214. | 209. | 314. | 204. | 399. | 5099. | 637. |
| 1969 | 247. | 244. | 364. | 234. | 460. | 5762. | 741. |
| 1970 | 282. | 282. | 416. | 266. | 522. | 6421. | 846. |
| 1971 | 318. | 320. | 470. | 299. | 586. | 7075. | 952. |
| 1972 | 355. | 360. | 524. | 334. | 652. | 7725. | 1059. |
| 1973 | 393. | 401. | 581. | 369. | 719. | 8369. | 1166. |
| 1974 | 433. | 443. | 637. | 407. | 787. | 9010. | 1276. |
| 1975 | 474. | 486. | 696. | 446. | 857. | 9645. | 1386. |
| 1976 | 516. | 530. | 756. | 485. | 928. | 10274. | 1497. |
| 1977 | 560. | 575. | 817. | 527. | 1001. | 10899. | 1609. |
| 1978 | 605. | 623. | 880. | 569. | 1075. | 11516. | 1722. |
| 1979 | 650. | 670. | 943. | 612. | 1150. | 12126. | 1837. |
| 1980 | 697. | 719. | 1008. | 656. | 1226. | 12728. | 1952. |
| 1981 | 731. | 753. | 1056. | 695. | 1284. | 13305. | 2062. |
| 1982 | 767. | 789. | 1106. | 734. | 1343. | 13873. | 2173. |
| 1983 | 801. | 824. | 1155. | 773. | 1401. | 14429. | 2284. |
| 1984 | 837. | 859. | 1206. | 813. | 1460. | 14973. | 2395. |
| 1985 | 873. | 895. | 1255. | 853. | 1519. | 15503. | 2505. |
| 1986 | 909. | 930. | 1305. | 892. | 1577. | 16018. | 2615. |
| 1987 | 945. | 967. | 1355. | 932. | 1636. | 16519. | 2725. |
| 1988 | 981. | 1002. | 1404. | 971. | 1695. | 17005. | 2834. |
| 1989 | 1018. | 1037. | 1453. | 1009. | 1754. | 17473. | 2942. |
| 1990 | 1054. | 1073. | 1502. | 1048. | 1812. | 17925. | 3049. |

Table 1-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | 0. | 0. |
| 1962 | 93. | 66. | 25. | 374. | 897. | 22128. | 162555. |
| 1963 | 214. | 159. | 58. | 742. | 2016. | 41570. | 323800. |
| 1964 | 352. | 261. | 96. | 1112. | 3234. | 62096. | 497750. |
| 1965 | 496. | 368. | 136. | 1484. | 4420. | 83178. | 712954. |
| 1966 | 622. | 464. | 171. | 1860. | 5782. | 103472. | 948147. |
| 1967 | 711. | 537. | 195. | 2236. | 6612. | 120853. | 1066960. |
| 1968 | 824. | 627. | 226. | 2614. | 7665. | 139615. | 1225403. |
| 1969 | 941. | 718. | 257. | 2996. | 8744. | 158496. | 1388793. |
| 1970 | 1061. | 813. | 290. | 3378. | 9851. | 177495. | 1555765. |
| 1971 | 1184. | 910. | 324. | 3763. | 10984. | 196609. | 1719110. |
| 1972 | 1311. | 1010. | 358. | 4149. | 12145. | 215833. | 1888964. |
| 1973 | 1441. | 1112. | 394. | 4535. | 13332. | 235166. | 2062502. |
| 1974 | 1575. | 1217. | 430. | 4922. | 14547. | 254606. | 2238179. |
| 1975 | 1712. | 1325. | 469. | 5311. | 15787. | 274150. | 2417057. |
| 1976 | 1851. | 1436. | 508. | 5699. | 17054. | 293798. | 2598125. |
| 1977 | 1994. | 1550. | 549. | 6087. | 18347. | 313545. | 2781905. |
| 1978 | 2140. | 1665. | 590. | 6475. | 19663. | 333390. | 2968297. |
| 1979 | 2289. | 1784. | 634. | 6862. | 21005. | 353329. | 3157296. |
| 1980 | 2441. | 1904. | 678. | 7250. | 22370. | 373358. | 3348854. |
| 1981 | 2581. | 2013. | 721. | 7571. | 23643. | 392536. | 3542320. |
| 1982 | 2722. | 2124. | 765. | 7889. | 24933. | 411749. | 3738409. |
| 1983 | 2866. | 2235. | 810. | 8204. | 26240. | 430990. | 3937174. |
| 1984 | 3011. | 2348. | 856. | 8513. | 27562. | 450250. | 4138503. |
| 1985 | 3158. | 2462. | 903. | 8819. | 28900. | 469519. | 4342440. |
| 1986 | 3306. | 2579. | 950. | 9121. | 30251. | 488787. | 4549059. |
| 1987 | 3456. | 2695. | 1000. | 9418. | 31618. | 508041. | 4758171. |
| 1988 | 3607. | 2813. | 1049. | 9710. | 32997. | 527272. | 4969712. |
| 1989 | 3758. | 2932. | 1101. | 9997. | 34390. | 546464. | 5183723. |
| 1990 | 3912. | 3051. | 1151. | 10279. | 35796. | 565609. | 5400146. |

Table I-22

# P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
--------

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 211. | 638. | 383. | 2. | 123. | 206. | 202. | 3. |
| 1963 | 540. | 1360. | 794. | 9. | 185. | 448. | 360. | 16. |
| 1964 | 893. | 2162. | 1250. | 52. | 326. | 745. | 618. | 57. |
| 1965 | 1274. | 2967. | 1741. | 118. | 425. | 1067. | 843. | 118. |
| 1966 | 1767. | 3819. | 2211. | 129. | 559. | 1337. | 1052. | 130. |
| 1967 | 2072. | 4119. | 2397. | 244. | 609. | 1446. | 1207. | 235. |
| 1968 | 2419. | 4621. | 2747. | 298. | 728. | 1660. | 1421. | 287. |
| 1969 | 2775. | 5143. | 3110. | 353. | 852. | 1882. | 1643. | 341. |
| 1970 | 3139. | 5687. | 3486. | 409. | 981. | 2112. | 1873. | 396. |
| 1971 | 3513. | 6252. | 3874. | 467. | 1117. | 2349. | 2113. | 454. |
| 1972 | 3897. | 6840. | 4278. | 526. | 1259. | 2596. | 2361. | 511. |
| 1973 | 4290. | 7451. | 4695. | 586. | 1407. | 2849. | 2618. | 572. |
| 1974 | 4695. | 8085. | 5127. | 646. | 1561. | 3112. | 2885. | 634. |
| 1975 | 5110. | 8743. | 5574. | 708. | 1723. | 3383. | 3161. | 698. |
| 1976 | 5536. | 9424. | 6036. | 771. | 1892. | 3664. | 3448. | 763. |
| 1977 | 5973. | 10130. | 6513. | 834. | 2067. | 3953. | 3743. | 831. |
| 1978 | 6420. | 10859. | 7003. | 899. | 2249. | 4250. | 4049. | 899. |
| 1979 | 6879. | 11612. | 7510. | 964. | 2440. | 4557. | 4363. | 970. |
| 1980 | 7348. | 12388. | 8029. | 1029. | 2636. | 4872. | 4689. | 1042. |
| 1981 | 7771. | 13175. | 8552. | 1092. | 2832. | 5182. | 4999. | 1107. |
| 1982 | 8202. | 13985. | 9088. | 1155. | 3036. | 5500. | 5317. | 1173. |
| 1983 | 8640. | 14817. | 9636. | 1219. | 3246. | 5825. | 5644. | 1240. |
| 1984 | 9083. | 15671. | 10196. | 1283. | 3463. | 6158. | 5980. | 1308. |
| 1985 | 9533. | 16548. | 10770. | 1347. | 3687. | 6498. | 6323. | 1376. |
| 1986 | 9987. | 17447. | 11355. | 1414. | 3917. | 6846. | 6675. | 1446. |
| 1987 | 10446. | 18368. | 11953. | 1479. | 4154. | 7201. | 7036. | 1516. |
| 1988 | 10910. | 19313. | 12564. | 1545. | 4398. | 7563. | 7406. | 1587. |
| 1989 | 11377. | 20280. | 13185. | 1613. | 4649. | 7933. | 7783. | 1659. |
| 1990 | 11849. | 21270. | 13818. | 1680. | 4908. | 8309. | 8169. | 1730. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 35. | 50. | 50. | 1002. | 21. |
| 1963 | 55. | 44. | 84. | 40. | 97. | 1699. | 121. |
| 1964 | 87. | 74. | 131. | 47. | 151. | 2390. | 222. |
| 1965 | 120. | 107. | 164. | 104. | 210. | 3078. | 326. |
| 1966 | 155. | 135. | 219. | 213. | 283. | 3757. | 435. |
| 1967 | 184. | 173. | 259. | 174. | 328. | 4433. | 535. |
| 1968 | 217. | 208. | 309. | 203. | 388. | 5102. | 639. |
| 1969 | 251. | 244. | 360. | 233. | 449. | 5766. | 743. |
| 1970 | 287. | 282. | 412. | 265. | 511. | 6425. | 848. |
| 1971 | 323. | 320. | 466. | 298. | 575. | 7080. | 954. |
| 1972 | 361. | 360. | 521. | 333. | 641. | 7731. | 1061. |
| 1973 | 401. | 401. | 578. | 369. | 708. | 8376. | 1168. |
| 1974 | 441. | 443. | 636. | 407. | 776. | 9018. | 1278. |
| 1975 | 484. | 486. | 695. | 446. | 847. | 9654. | 1389. |
| 1976 | 526. | 530. | 756. | 485. | 918. | 10284. | 1499. |
| 1977 | 571. | 576. | 818. | 527. | 991. | 10909. | 1612. |
| 1978 | 617. | 623. | 882. | 570. | 1065. | 11528. | 1725. |
| 1979 | 664. | 671. | 946. | 613. | 1141. | 12139. | 1840. |
| 1980 | 712. | 719. | 1012. | 658. | 1217. | 12743. | 1955. |
| 1981 | 748. | 754. | 1062. | 696. | 1276. | 13321. | 2066. |
| 1982 | 785. | 790. | 1113. | 736. | 1335. | 13890. | 2176. |
| 1983 | 821. | 825. | 1163. | 776. | 1394. | 14447. | 2288. |
| 1984 | 858. | 861. | 1215. | 816. | 1453. | 14993. | 2398. |
| 1985 | 896. | 897. | 1266. | 856. | 1512. | 15525. | 2509. |
| 1986 | 934. | 932. | 1318. | 896. | 1571. | 16042. | 2619. |
| 1987 | 971. | 968. | 1369. | 936. | 1632. | 16545. | 2729. |
| 1988 | 1010. | 1004. | 1420. | 975. | 1691. | 17032. | 2838. |
| 1989 | 1049. | 1039. | 1472. | 1014. | 1751. | 17503. | 2946. |
| 1990 | 1087. | 1075. | 1523. | 1053. | 1810. | 17957. | 3054. |

Table I-22

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | ACTUARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | 0. | 0. |
| 1962 | 117. | 80. | 33. | 374. | 948. | 22175. | 162389. |
| 1963 | 270. | 189. | 77. | 743. | 2159. | 41685. | 323281. |
| 1964 | 417. | 291. | 115. | 1113. | 3443. | 62520. | 500050. |
| 1965 | 589. | 410. | 164. | 1485. | 4673. | 83553. | 714810. |
| 1966 | 726. | 506. | 198. | 1861. | 6171. | 104783. | 953278. |
| 1967 | 824. | 590. | 227. | 2236. | 6985. | 121974. | 1070412. |
| 1968 | 945. | 685. | 261. | 2615. | 8082. | 141126. | 1233295. |
| 1969 | 1071. | 783. | 296. | 2997. | 9208. | 160428. | 1401463. |
| 1970 | 1199. | 885. | 333. | 3380. | 10365. | 179879. | 1573572. |
| 1971 | 1332. | 989. | 370. | 3764. | 11553. | 199478. | 1742434. |
| 1972 | 1469. | 1098. | 409. | 4150. | 12771. | 219222. | 1918209. |
| 1973 | 1609. | 1208. | 449. | 4537. | 14020. | 239111. | 2098097. |
| 1974 | 1753. | 1322. | 490. | 4924. | 15300. | 259145. | 2280575. |
| 1975 | 1902. | 1439. | 533. | 5313. | 16610. | 279325. | 2466734. |
| 1976 | 2053. | 1560. | 578. | 5701. | 17951. | 299650. | 2655591. |
| 1977 | 2209. | 1684. | 624. | 6090. | 19323. | 320118. | 2847694. |
| 1978 | 2369. | 1810. | 671. | 6478. | 20723. | 340732. | 3042974. |
| 1979 | 2532. | 1940. | 720. | 6866. | 22154. | 361487. | 3241457. |
| 1980 | 2699. | 2073. | 771. | 7253. | 23614. | 382384. | 3443129. |
| 1981 | 2854. | 2194. | 820. | 7575. | 24987. | 402483. | 3647371. |
| 1982 | 3013. | 2318. | 872. | 7894. | 26384. | 422673. | 3854934. |
| 1983 | 3173. | 2444. | 924. | 8208. | 27803. | 442950. | 4065907. |
| 1984 | 3337. | 2572. | 978. | 8518. | 29245. | 463308. | 4280217. |
| 1985 | 3504. | 2702. | 1033. | 8825. | 30708. | 483740. | 4497948. |
| 1986 | 3672. | 2835. | 1089. | 9127. | 32193. | 504238. | 4719214. |
| 1987 | 3844. | 2969. | 1147. | 9424. | 33701. | 524792. | 4943872. |
| 1988 | 4018. | 3105. | 1207. | 9717. | 35229. | 545398. | 5171903. |
| 1989 | 4193. | 3243. | 1268. | 10004. | 36779. | 566042. | 5403395. |
| 1990 | 4372. | 3383. | 1329. | 10287. | 38351. | 586721. | 5638341. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 208. | 545. | 339. | 5. | 138. | 188. | 228. | 4. |
| 1963 | 539. | 1097. | 689. | 17. | 270. | 406. | 454. | 18. |
| 1964 | 883. | 1762. | 1088. | 62. | 434. | 661. | 731. | 60. |
| 1965 | 1273. | 2485. | 1513. | 129. | 610. | 938. | 1032. | 121. |
| 1966 | 1752. | 3072. | 1888. | 142. | 745. | 1170. | 1262. | 134. |
| 1967 | 2073. | 3357. | 2131. | 255. | 805. | 1323. | 1415. | 239. |
| 1968 | 2423. | 3847. | 2467. | 310. | 920. | 1531. | 1630. | 291. |
| 1969 | 2780. | 4356. | 2815. | 366. | 1040. | 1747. | 1853. | 345. |
| 1970 | 3147. | 4885. | 3175. | 423. | 1165. | 1969. | 2083. | 400. |
| 1971 | 3523. | 5436. | 3547. | 482. | 1296. | 2199. | 2324. | 458. |
| 1972 | 3910. | 6009. | 3934. | 543. | 1433. | 2438. | 2572. | 515. |
| 1973 | 4306. | 6603. | 4333. | 604. | 1576. | 2683. | 2830. | 576. |
| 1974 | 4714. | 7221. | 4745. | 666. | 1725. | 2937. | 3097. | 638. |
| 1975 | 5132. | 7861. | 5172. | 728. | 1881. | 3199. | 3374. | 703. |
| 1976 | 5561. | 8523. | 5612. | 793. | 2043. | 3470. | 3661. | 768. |
| 1977 | 6003. | 9209. | 6067. | 858. | 2211. | 3748. | 3957. | 835. |
| 1978 | 6453. | 9918. | 6533. | 924. | 2386. | 4035. | 4262. | 904. |
| 1979 | 6916. | 10649. | 7015. | 991. | 2569. | 4330. | 4577. | 975. |
| 1980 | 7389. | 11403. | 7508. | 1057. | 2757. | 4633. | 4903. | 1046. |
| 1981 | 7817. | 12165. | 8004. | 1122. | 2945. | 4930. | 5213. | 1112. |
| 1982 | 8252. | 12950. | 8511. | 1187. | 3140. | 5234. | 5531. | 1178. |
| 1983 | 8695. | 13756. | 9030. | 1253. | 3341. | 5546. | 5857. | 1245. |
| 1984 | 9143. | 14583. | 9559. | 1319. | 3548. | 5863. | 6193. | 1313. |
| 1985 | 9599. | 15431. | 10100. | 1386. | 3760. | 6188. | 6536. | 1381. |
| 1986 | 10059. | 16300. | 10651. | 1454. | 3980. | 6520. | 6888. | 1451. |
| 1987 | 10524. | 17189. | 11214. | 1522. | 4205. | 6858. | 7248. | 1521. |
| 1988 | 10994. | 18101. | 11787. | 1590. | 4437. | 7203. | 7617. | 1593. |
| 1989 | 11468. | 19034. | 12369. | 1660. | 4675. | 7554. | 7993. | 1665. |
| 1990 | 11947. | 19988. | 12963. | 1730. | 4920. | 7912. | 8377. | 1736. |



Table I-22

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 36. | 50. | 52. | 1001. | 21. |
| 1963 | 54. | 45. | 86. | 41. | 102. | 1697. | 120. |
| 1964 | 85. | 74. | 135. | 48. | 156. | 2389. | 221. |
| 1965 | 118. | 107. | 170. | 105. | 220. | 3076. | 324. |
| 1966 | 151. | 136. | 226. | 214. | 294. | 3755. | 432. |
| 1967 | 181. | 174. | 264. | 175. | 339. | 4430. | 534. |
| 1968 | 214. | 209. | 315. | 204. | 399. | 5099. | 637. |
| 1969 | 247. | 244. | 365. | 234. | 461. | 5763. | 741. |
| 1970 | 283. | 282. | 418. | 266. | 523. | 6422. | 846. |
| 1971 | 319. | 320. | 471. | 299. | 588. | 7076. | 953. |
| 1972 | 357. | 360. | 526. | 334. | 654. | 7727. | 1059. |
| 1973 | 396. | 401. | 583. | 369. | 722. | 8372. | 1167. |
| 1974 | 436. | 444. | 640. | 408. | 791. | 9013. | 1276. |
| 1975 | 478. | 487. | 700. | 446. | 861. | 9649. | 1387. |
| 1976 | 520. | 531. | 760. | 486. | 933. | 10278. | 1498. |
| 1977 | 565. | 576. | 822. | 528. | 1007. | 10903. | 1611. |
| 1978 | 610. | 624. | 885. | 570. | 1081. | 11521. | 1724. |
| 1979 | 656. | 672. | 949. | 613. | 1158. | 12132. | 1839. |
| 1980 | 704. | 720. | 1014. | 657. | 1235. | 12735. | 1954. |
| 1981 | 740. | 755. | 1064. | 696. | 1294. | 13313. | 2065. |
| 1982 | 776. | 791. | 1114. | 736. | 1353. | 13882. | 2175. |
| 1983 | 812. | 826. | 1164. | 775. | 1413. | 14438. | 2287. |
| 1984 | 849. | 862. | 1216. | 815. | 1473. | 14983. | 2397. |
| 1985 | 886. | 898. | 1266. | 855. | 1533. | 15514. | 2508. |
| 1986 | 923. | 933. | 1317. | 894. | 1592. | 16030. | 2618. |
| 1987 | 960. | 970. | 1368. | 934. | 1653. | 16533. | 2728. |
| 1988 | 997. | 1005. | 1418. | 974. | 1713. | 17019. | 2838. |
| 1989 | 1036. | 1041. | 1469. | 1012. | 1774. | 17489. | 2946. |
| 1990 | 1073. | 1076. | 1519. | 1051. | 1834. | 17942. | 3054. |

Table I-22

(Page 47 of 72)
Projection 4-B

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | ACTUARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | 0. | 0. |
| 1962 | 93. | 66. | 25. | 374. | 897. | 22128. | 162555. |
| 1963 | 214. | 159. | 58. | 742. | 2016. | 41570. | 323800. |
| 1964 | 352. | 261. | 96. | 1112. | 3234. | 62096. | 497750. |
| 1965 | 496. | 368. | 136. | 1484. | 4420. | 83178. | 712954. |
| 1966 | 622. | 464. | 171. | 1860. | 5782. | 103472. | 948147. |
| 1967 | 711. | 537. | 195. | 2236. | 6612. | 120853. | 1066960. |
| 1968 | 828. | 629. | 227. | 2614. | 7697. | 139904. | 1230206. |
| 1969 | 950. | 724. | 260. | 2996. | 8811. | 159098. | 1398759. |
| 1970 | 1075. | 822. | 294. | 3379. | 9956. | 178432. | 1571274. |
| 1971 | 1204. | 922. | 329. | 3764. | 11130. | 197904. | 1740565. |
| 1972 | 1337. | 1026. | 365. | 4150. | 12334. | 217513. | 1916788. |
| 1973 | 1473. | 1132. | 403. | 4537. | 13567. | 237257. | 2097144. |
| 1974 | 1613. | 1241. | 441. | 4924. | 14831. | 257137. | 2280111. |
| 1975 | 1757. | 1354. | 481. | 5313. | 16125. | 277151. | 2466776. |
| 1976 | 1904. | 1469. | 522. | 5701. | 17448. | 297301. | 2656158. |
| 1977 | 2055. | 1588. | 565. | 6090. | 18801. | 317583. | 2848805. |
| 1978 | 2210. | 1709. | 609. | 6478. | 20182. | 337999. | 3044648. |
| 1979 | 2368. | 1833. | 655. | 6866. | 21591. | 358546. | 3243713. |
| 1980 | 2530. | 1960. | 702. | 7253. | 23029. | 379221. | 3445985. |
| 1981 | 2680. | 2075. | 747. | 7575. | 24379. | 399087. | 3650848. |
| 1982 | 2833. | 2193. | 795. | 7894. | 25752. | 419032. | 3859052. |
| 1983 | 2988. | 2312. | 843. | 8209. | 27146. | 439050. | 4070689. |
| 1984 | 3145. | 2433. | 892. | 8519. | 28561. | 459135. | 4285687. |
| 1985 | 3306. | 2555. | 943. | 8825. | 29997. | 479280. | 4504132. |
| 1986 | 3468. | 2680. | 994. | 9127. | 31453. | 499477. | 4726140. |
| 1987 | 3633. | 2806. | 1047. | 9425. | 32930. | 519716. | 4951568. |
| 1988 | 3800. | 2934. | 1101. | 9717. | 34427. | 539991. | 5180402. |
| 1989 | 3968. | 3063. | 1157. | 10005. | 35944. | 560289. | 5412731. |
| 1990 | 4139. | 3194. | 1212. | 10288. | 37482. | 580604. | 5648553. |

Table I-22

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 211. | 638. | 383. | 2. | 123. | 206. | 202. | 3. |
| 1963 | 540. | 1360. | 794. | 9. | 185. | 448. | 360. | 16. |
| 1964 | 893. | 2162. | 1250. | 52. | 326. | 745. | 618. | 57. |
| 1965 | 1274. | 2967. | 1741. | 118. | 425. | 1067. | 843. | 118. |
| 1966 | 1767. | 3819. | 2211. | 129. | 559. | 1337. | 1052. | 130. |
| 1967 | 2072. | 4119. | 2397. | 244. | 609. | 1446. | 1207. | 235. |
| 1968 | 2423. | 4661. | 2764. | 298. | 737. | 1672. | 1432. | 287. |
| 1969 | 2783. | 5227. | 3145. | 353. | 870. | 1908. | 1666. | 342. |
| 1970 | 3152. | 5817. | 3540. | 410. | 1010. | 2151. | 1909. | 397. |
| 1971 | 3531. | 6434. | 3950. | 468. | 1158. | 2404. | 2163. | 454. |
| 1972 | 3921. | 7077. | 4376. | 528. | 1313. | 2668. | 2426. | 512. |
| 1973 | 4320. | 7747. | 4819. | 588. | 1475. | 2940. | 2701. | 573. |
| 1974 | 4731. | 8445. | 5278. | 650. | 1644. | 3223. | 2985. | 635. |
| 1975 | 5153. | 9172. | 5754. | 711. | 1822. | 3516. | 3281. | 700. |
| 1976 | 5586. | 9927. | 6248. | 775. | 2008. | 3820. | 3588. | 766. |
| 1977 | 6032. | 10712. | 6759. | 839. | 2201. | 4134. | 3906. | 834. |
| 1978 | 6487. | 11526. | 7287. | 905. | 2404. | 4458. | 4235. | 902. |
| 1979 | 6955. | 12370. | 7834. | 971. | 2616. | 4794. | 4575. | 974. |
| 1980 | 7432. | 13245. | 8396. | 1036. | 2836. | 5140. | 4928. | 1046. |
| 1981 | 7866. | 14136. | 8965. | 1100. | 3057. | 5483. | 5268. | 1112. |
| 1982 | 8307. | 15058. | 9551. | 1164. | 3287. | 5838. | 5617. | 1178. |
| 1983 | 8757. | 16009. | 10153. | 1229. | 3526. | 6202. | 5977. | 1245. |
| 1984 | 9212. | 16992. | 10771. | 1294. | 3774. | 6576. | 6349. | 1314. |
| 1985 | 9675. | 18005. | 11407. | 1360. | 4030. | 6961. | 6730. | 1383. |
| 1986 | 10143. | 19050. | 12058. | 1427. | 4295. | 7356. | 7123. | 1454. |
| 1987 | 10617. | 20126. | 12727. | 1494. | 4569. | 7762. | 7528. | 1524. |
| 1988 | 11096. | 21237. | 13413. | 1561. | 4853. | 8179. | 7943. | 1597. |
| 1989 | 11580. | 22381. | 14115. | 1630. | 5146. | 8606. | 8369. | 1669. |
| 1990 | 12069. | 23560. | 14834. | 1699. | 5450. | 9045. | 8807. | 1741. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

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| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 35. | 50. | 50. | 1002. | 21. |
| 1963 | 55. | 44. | 84. | 40. | 97. | 1699. | 121. |
| 1964 | 87. | 74. | 131. | 47. | 151. | 2390. | 222. |
| 1965 | 120. | 107. | 164. | 104. | 210. | 3078. | 326. |
| 1966 | 155. | 135. | 219. | 213. | 283. | 3757. | 435. |
| 1967 | 184. | 173. | 259. | 174. | 328. | 4433. | 535. |
| 1968 | 218. | 208. | 309. | 203. | 388. | 5103. | 639. |
| 1969 | 252. | 244. | 360. | 233. | 449. | 5767. | 743. |
| 1970 | 288. | 282. | 413. | 266. | 512. | 6426. | 849. |
| 1971 | 326. | 320. | 467. | 299. | 576. | 7082. | 955. |
| 1972 | 364. | 360. | 522. | 334. | 642. | 7732. | 1062. |
| 1973 | 404. | 401. | 579. | 369. | 710. | 8378. | 1170. |
| 1974 | 445. | 444. | 637. | 407. | 778. | 9021. | 1279. |
| 1975 | 488. | 487. | 697. | 446. | 849. | 9657. | 1390. |
| 1976 | 532. | 531. | 758. | 486. | 921. | 10288. | 1501. |
| 1977 | 578. | 577. | 820. | 528. | 995. | 10913. | 1614. |
| 1978 | 625. | 624. | 884. | 570. | 1069. | 11532. | 1728. |
| 1979 | 672. | 672. | 949. | 614. | 1145. | 12144. | 1843. |
| 1980 | 722. | 721. | 1015. | 658. | 1222. | 12748. | 1958. |
| 1981 | 759. | 756. | 1065. | 697. | 1281. | 13327. | 2069. |
| 1982 | 798. | 792. | 1116. | 738. | 1341. | 13898. | 2180. |
| 1983 | 835. | 827. | 1167. | 777. | 1400. | 14455. | 2291. |
| 1984 | 874. | 863. | 1219. | 818. | 1460. | 15002. | 2402. |
| 1985 | 914. | 900. | 1271. | 857. | 1521. | 15534. | 2514. |
| 1986 | 954. | 935. | 1323. | 897. | 1580. | 16053. | 2624. |
| 1987 | 993. | 972. | 1375. | 938. | 1642. | 16557. | 2734. |
| 1988 | 1034. | 1008. | 1427. | 977. | 1702. | 17045. | 2844. |
| 1989 | 1075. | 1043. | 1478. | 1016. | 1763. | 17517. | 2953. |
| 1990 | 1115. | 1080. | 1531. | 1055. | 1823. | 17972. | 3060. |

Table I-22

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Projection 5-B

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING ANC OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | 0. | 0. |
| 1962 | 117. | 80. | 33. | 374. | 948. | 22175. | 162389. |
| 1963 | 270. | 189. | 77. | 743. | 2159. | 41685. | 323281. |
| 1964 | 417. | 291. | 115. | 1113. | 3443. | 62520. | 500050. |
| 1965 | 589. | 410. | 164. | 1485. | 4673. | 83553. | 714810. |
| 1966 | 726. | 506. | 198. | 1861. | 6171. | 104783. | 953278. |
| 1967 | 824. | 590. | 227. | 2236. | 6985. | 121974. | 1070412. |
| 1968 | 950. | 689. | 262. | 2615. | 8117. | 141425. | 1238194. |
| 1969 | 1082. | 790. | 299. | 2997. | 9282. | 161052. | 1411679. |
| 1970 | 1217. | 895. | 338. | 3380. | 10481. | 180859. | 1589546. |
| 1971 | 1356. | 1004. | 377. | 3765. | 11714. | 200842. | 1764638. |
| 1972 | 1500. | 1116. | 417. | 4151. | 12981. | 221004. | 1947138. |
| 1973 | 1649. | 1231. | 460. | 4538. | 14283. | 241347. | 2134277. |
| 1974 | 1801. | 1350. | 503. | 4926. | 15621. | 261871. | 2324567. |
| 1975 | 1959. | 1472. | 550. | 5315. | 16993. | 282580. | 2519129. |
| 1976 | 2120. | 1599. | 597. | 5704. | 18401. | 303477. | 2717019. |
| 1977 | 2286. | 1729. | 646. | 6092. | 19844. | 324562. | 2918822. |
| 1978 | 2457. | 1862. | 697. | 6481. | 21322. | 345840. | 3124510. |
| 1979 | 2631. | 1999. | 750. | 6869. | 22836. | 367311. | 3334153. |
| 1980 | 2811. | 2139. | 805. | 7257. | 24385. | 388976. | 3547782. |
| 1981 | 2980. | 2269. | 858. | 7579. | 25854. | 409901. | 3764829. |
| 1982 | 3152. | 2401. | 914. | 7898. | 27353. | 430977. | 3986095. |
| 1983 | 3328. | 2537. | 972. | 8214. | 28883. | 452205. | 4211724. |
| 1984 | 3508. | 2674. | 1030. | 8524. | 30443. | 473581. | 4441701. |
| 1985 | 3692. | 2815. | 1091. | 8831. | 32032. | 495102. | 4676170. |
| 1986 | 3879. | 2959. | 1154. | 9134. | 33652. | 516766. | 4915311. |
| 1987 | 4070. | 3105. | 1218. | 9432. | 35304. | 538568. | 5159045. |
| 1988 | 4265. | 3254. | 1285. | 9726. | 36987. | 560505. | 5407427. |
| 1989 | 4462. | 3405. | 1353. | 10014. | 38701. | 582572. | 5660618. |
| 1990 | 4665. | 3560. | 1423. | 10298. | 40448. | 604768. | 5918691. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 208. | 545. | 339. | 5. | 138. | 188. | 228. | 4. |
| 1963 | 539. | 1097. | 689. | 17. | 270. | 406. | 454. | 18. |
| 1964 | 883. | 1762. | 1088. | 62. | 434. | 661. | 731. | 60. |
| 1965 | 1273. | 2485. | 1513. | 129. | 610. | 938. | 1032. | 121. |
| 1966 | 1752. | 3072. | 1888. | 142. | 745. | 1170. | 1262. | 134. |
| 1967 | 2073. | 3357. | 2131. | 255. | 805. | 1323. | 1415. | 239. |
| 1968 | 2426. | 3881. | 2482. | 311. | 929. | 1542. | 1643. | 291. |
| 1969 | 2788. | 4427. | 2845. | 367. | 1059. | 1768. | 1879. | 345. |
| 1970 | 3159. | 4996. | 3222. | 424. | 1194. | 2002. | 2125. | 401. |
| 1971 | 3541. | 5590. | 3612. | 484. | 1337. | 2245. | 2381. | 458. |
| 1972 | 3932. | 6209. | 4018. | 545. | 1487. | 2498. | 2647. | 517. |
| 1973 | 4334. | 6854. | 4438. | 607. | 1643. | 2758. | 2923. | 577. |
| 1974 | 4749. | 7526. | 4874. | 669. | 1806. | 3028. | 3211. | 640. |
| 1975 | 5173. | 8225. | 5325. | 732. | 1978. | 3308. | 3509. | 704. |
| 1976 | 5609. | 8950. | 5792. | 798. | 2157. | 3597. | 3820. | 770. |
| 1977 | 6058. | 9703. | 6275. | 864. | 2343. | 3896. | 4140. | 838. |
| 1978 | 6517. | 10484. | 6772. | 930. | 2538. | 4204. | 4473. | 907. |
| 1979 | 6989. | 11293. | 7286. | 998. | 2741. | 4522. | 4817. | 978. |
| 1980 | 7471. | 12130. | 7815. | 1066. | 2951. | 4850. | 5174. | 1050. |
| 1981 | 7909. | 12982. | 8348. | 1131. | 3163. | 5173. | 5517. | 1116. |
| 1982 | 8355. | 13863. | 8895. | 1198. | 3383. | 5506. | 5871. | 1182. |
| 1983 | 8810. | 14771. | 9457. | 1265. | 3612. | 5848. | 6235. | 1250. |
| 1984 | 9270. | 15707. | 10032. | 1332. | 3848. | 6199. | 6612. | 1319. |
| 1985 | 9739. | 16671. | 10623. | 1400. | 4092. | 6558. | 6998. | 1388. |
| 1986 | 10213. | 17665. | 11226. | 1470. | 4345. | 6927. | 7396. | 1458. |
| 1987 | 10693. | 18687. | 11844. | 1539. | 4605. | 7305. | 7806. | 1529. |
| 1988 | 11179. | 19741. | 12477. | 1609. | 4875. | 7692. | 8227. | 1601. |
| 1989 | 11670. | 20825. | 13124. | 1681. | 5153. | 8089. | 8660. | 1674. |
| 1990 | 12167. | 21940. | 13785. | 1753. | 5441. | 8494. | 9104. | 1746. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
--------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 36. | 50. | 52. | 1001. | 21. |
| 1963 | 54. | 45. | 86. | 41. | 102. | 1697. | 120. |
| 1964 | 85. | 74. | 135. | 48. | 156. | 2389. | 221. |
| 1965 | 118. | 107. | 170. | 105. | 220. | 3076. | 324. |
| 1966 | 151. | 136. | 226. | 214. | 294. | 3755. | 432. |
| 1967 | 181. | 174. | 264. | 175. | 339. | 4430. | 534. |
| 1968 | 214. | 209. | 315. | 204. | 400. | 5100. | 637. |
| 1969 | 248. | 245. | 366. | 234. | 462. | 5764. | 741. |
| 1970 | 284. | 283. | 419. | 267. | 525. | 6423. | 847. |
| 1971 | 321. | 321. | 473. | 300. | 590. | 7078. | 953. |
| 1972 | 359. | 361. | 528. | 335. | 657. | 7728. | 1060. |
| 1973 | 399. | 402. | 585. | 370. | 725. | 8374. | 1167. |
| 1974 | 439. | 444. | 643. | 408. | 795. | 9016. | 1277. |
| 1975 | 482. | 488. | 703. | 447. | 866. | 9652. | 1388. |
| 1976 | 525. | 532. | 764. | 487. | 938. | 10282. | 1499. |
| 1977 | 570. | 578. | 827. | 529. | 1013. | 10908. | 1612. |
| 1978 | 617. | 625. | 890. | 571. | 1088. | 11527. | 1725. |
| 1979 | 663. | 673. | 955. | 614. | 1166. | 12138. | 1841. |
| 1980 | 712. | 722. | 1021. | 659. | 1244. | 12742. | 1956. |
| 1981 | 749. | 757. | 1072. | 698. | 1304. | 13321. | 2067. |
| 1982 | 786. | 793. | 1123. | 738. | 1364. | 13890. | 2177. |
| 1983 | 823. | 828. | 1174. | 777. | 1425. | 14448. | 2289. |
| 1984 | 861. | 864. | 1226. | 817. | 1486. | 14994. | 2400. |
| 1985 | 899. | 901. | 1278. | 857. | 1548. | 15526. | 2511. |
| 1986 | 938. | 936. | 1330. | 897. | 1609. | 16044. | 2622. |
| 1987 | 976. | 973. | 1382. | 937. | 1672. | 16547. | 2732. |
| 1988 | 1016. | 1009. | 1434. | 976. | 1734. | 17035. | 2842. |
| 1989 | 1055. | 1045. | 1486. | 1015. | 1796. | 17506. | 2951. |
| 1990 | 1095. | 1081. | 1538. | 1054. | 1858. | 17960. | 3059. |



Table I-22

# P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961 ASSUMED CONSTANT
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | 0. | 0. |
| 1962 | 93. | 66. | 25. | 374. | 897. | 22128. | 162555. |
| 1963 | 214. | 159. | 58. | 742. | 2016. | 41570. | 323800. |
| 1964 | 352. | 261. | 96. | 1112. | 3234. | 62096. | 497750. |
| 1965 | 496. | 368. | 136. | 1484. | 4420. | 83178. | 712954. |
| 1966 | 622. | 464. | 171. | 1860. | 5782. | 103472. | 948147. |
| 1967 | 711. | 537. | 195. | 2236. | 6612. | 120853. | 1066960. |
| 1968 | 833. | 632. | 228. | 2614. | 7730. | 140194. | 1235009. |
| 1969 | 960. | 729. | 262. | 2996. | 8879. | 159702. | 1408773. |
| 1970 | 1089. | 831. | 298. | 3379. | 10062. | 179377. | 1586934. |
| 1971 | 1224. | 934. | 334. | 3764. | 11277. | 199218. | 1762332. |
| 1972 | 1363. | 1042. | 372. | 4151. | 12526. | 219225. | 1945153. |
| 1973 | 1506. | 1152. | 411. | 4538. | 13808. | 239399. | 2132629. |
| 1974 | 1653. | 1266. | 451. | 4925. | 15124. | 259742. | 2323269. |
| 1975 | 1804. | 1383. | 494. | 5315. | 16474. | 280255. | 2518197. |
| 1976 | 1959. | 1504. | 537. | 5704. | 17857. | 300942. | 2716466. |
| 1977 | 2119. | 1628. | 582. | 6092. | 19275. | 321800. | 2918663. |
| 1978 | 2283. | 1755. | 629. | 6481. | 20725. | 342835. | 3124759. |
| 1979 | 2451. | 1886. | 677. | 6869. | 22209. | 364046. | 3334823. |
| 1980 | 2624. | 2019. | 728. | 7257. | 23727. | 385433. | 3548884. |
| 1981 | 2786. | 2142. | 776. | 7579. | 25163. | 406061. | 3766375. |
| 1982 | 2951. | 2267. | 826. | 7899. | 26627. | 426822. | 3988095. |
| 1983 | 3119. | 2394. | 878. | 8214. | 28119. | 447712. | 4214189. |
| 1984 | 3291. | 2524. | 931. | 8525. | 29640. | 468731. | 4444640. |
| 1985 | 3466. | 2656. | 986. | 8832. | 31187. | 489872. | 4679593. |
| 1986 | 3644. | 2791. | 1041. | 9135. | 32763. | 511133. | 4919226. |
| 1987 | 3826. | 2928. | 1099. | 9433. | 34368. | 532508. | 5163462. |
| 1988 | 4012. | 3067. | 1158. | 9726. | 36001. | 553993. | 5412355. |
| 1989 | 4199. | 3208. | 1219. | 10015. | 37663. | 575582. | 5666067. |
| 1990 | 4391. | 3352. | 1280. | 10298. | 39355. | 597273. | 5924671. |

Table 1-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 176. | 600. | 376. | -21. | 112. | 206. | 202. | 3. |
| 1963 | 466. | 1282. | 780. | -35. | 162. | 448. | 360. | 16. |
| 1964 | 778. | 2019. | 1228. | -15. | 287. | 745. | 618. | 57. |
| 1965 | 1105. | 2783. | 1710. | 22. | 368. | 1067. | 843. | 118. |
| 1966 | 1513. | 3509. | 2163. | 16. | 481. | 1337. | 1052. | 130. |
| 1967 | 1760. | 3757. | 2338. | 84. | 517. | 1446. | 1207. | 235. |
| 1968 | 2039. | 4151. | 2661. | 105. | 606. | 1648. | 1410. | 287. |
| 1969 | 2322. | 4559. | 2994. | 124. | 698. | 1857. | 1620. | 341. |
| 1970 | 2608. | 4983. | 3338. | 143. | 793. | 2073. | 1837. | 396. |
| 1971 | 2901. | 5423. | 3694. | 161. | 892. | 2295. | 2063. | 453. |
| 1972 | 3259. | 5945. | 4073. | 210. | 1013. | 2525. | 2295. | 510. |
| 1973 | 3626. | 6485. | 4464. | 260. | 1139. | 2761. | 2537. | 570. |
| 1974 | 4004. | 7046. | 4868. | 309. | 1270. | 3005. | 2786. | 632. |
| 1975 | 4390. | 7625. | 5285. | 359. | 1407. | 3257. | 3044. | 696. |
| 1976 | 4786. | 8223. | 5716. | 410. | 1549. | 3517. | 3310. | 761. |
| 1977 | 5193. | 8840. | 6158. | 462. | 1696. | 3783. | 3585. | 828. |
| 1978 | 5607. | 9476. | 6613. | 514. | 1848. | 4056. | 3867. | 896. |
| 1979 | 6033. | 10130. | 7080. | 566. | 2007. | 4336. | 4158. | 967. |
| 1980 | 6466. | 10802. | 7558. | 618. | 2170. | 4623. | 4457. | 1038. |
| 1981 | 6854. | 11478. | 8037. | 667. | 2331. | 4904. | 4740. | 1103. |
| 1982 | 7247. | 12171. | 8526. | 716. | 2498. | 5190. | 5029. | 1168. |
| 1983 | 7646. | 12879. | 9025. | 765. | 2669. | 5483. | 5324. | 1234. |
| 1984 | 8048. | 13603. | 9532. | 814. | 2845. | 5779. | 5627. | 1302. |
| 1985 | 8456. | 14341. | 10051. | 862. | 3024. | 6082. | 5935. | 1370. |
| 1986 | 8866. | 15094. | 10576. | 912. | 3209. | 6390. | 6251. | 1439. |
| 1987 | 9279. | 15861. | 11111. | 961. | 3397. | 6702. | 6572. | 1508. |
| 1988 | 9695. | 16644. | 11655. | 1009. | 3590. | 7019. | 6899. | 1579. |
| 1989 | 10113. | 17439. | 12205. | 1059. | 3787. | 7341. | 7232. | 1650. |
| 1990 | 10533. | 18248. | 12764. | 1108. | 3989. | 7667. | 7570. | 1720. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
--------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 35. | 63. | 50. | 1002. | 20. |
| 1963 | 55. | 44. | 84. | 65. | 97. | 1699. | 118. |
| 1964 | 87. | 74. | 131. | 83. | 151. | 2390. | 218. |
| 1965 | 120. | 107. | 164. | 156. | 210. | 3079. | 320. |
| 1966 | 155. | 135. | 219. | 290. | 283. | 3758. | 426. |
| 1967 | 184. | 173. | 259. | 257. | 328. | 4434. | 524. |
| 1968 | 217. | 208. | 309. | 302. | 387. | 5103. | 625. |
| 1969 | 250. | 244. | 359. | 347. | 448. | 5767. | 727. |
| 1970 | 285. | 282. | 412. | 396. | 510. | 6426. | 829. |
| 1971 | 321. | 319. | 466. | 446. | 574. | 7082. | 932. |
| 1972 | 359. | 359. | 520. | 483. | 639. | 7732. | 1038. |
| 1973 | 397. | 400. | 577. | 521. | 707. | 8377. | 1145. |
| 1974 | 437. | 442. | 635. | 562. | 774. | 9018. | 1253. |
| 1975 | 479. | 485. | 694. | 603. | 844. | 9654. | 1363. |
| 1976 | 521. | 529. | 755. | 645. | 915. | 10284. | 1473. |
| 1977 | 565. | 575. | 816. | 689. | 988. | 10909. | 1584. |
| 1978 | 610. | 622. | 879. | 734. | 1061. | 11527. | 1696. |
| 1979 | 655. | 669. | 943. | 780. | 1137. | 12137. | 1810. |
| 1980 | 703. | 718. | 1009. | 827. | 1213. | 12741. | 1924. |
| 1981 | 737. | 752. | 1058. | 868. | 1270. | 13319. | 2033. |
| 1982 | 773. | 788. | 1109. | 911. | 1328. | 13888. | 2142. |
| 1983 | 808. | 823. | 1159. | 953. | 1387. | 14444. | 2252. |
| 1984 | 844. | 858. | 1211. | 996. | 1445. | 14989. | 2362. |
| 1985 | 880. | 894. | 1261. | 1039. | 1504. | 15520. | 2471. |
| 1986 | 917. | 929. | 1312. | 1081. | 1562. | 16037. | 2579. |
| 1987 | 952. | 965. | 1363. | 1124. | 1621. | 16539. | 2688. |
| 1988 | 989. | 1000. | 1414. | 1167. | 1680. | 17026. | 2796. |
| 1989 | 1026. | 1036. | 1464. | 1208. | 1739. | 17496. | 2902. |
| 1990 | 1062. | 1071. | 1515. | 1250. | 1797. | 17949. | 3008. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | 0. | 0. |
| 1962 | 132. | 80. | 33. | 374. | 1059. | 22245. | 143703. |
| 1963 | 305. | 189. | 77. | 743. | 2402. | 41879. | 283751. |
| 1964 | 474. | 291. | 115. | 1113. | 3841. | 62847. | 436439. |
| 1965 | 674. | 410. | 164. | 1485. | 5239. | 84083. | 622869. |
| 1966 | 839. | 506. | 198. | 1861. | 6959. | 105372. | 828090. |
| 1967 | 961. | 590. | 227. | 2236. | 7933. | 122626. | 918613. |
| 1968 | 1106. | 682. | 260. | 2615. | 9189. | 141621. | 1044837. |
| 1969 | 1256. | 777. | 293. | 2996. | 10484. | 160752. | 1173886. |
| 1970 | 1410. | 875. | 328. | 3379. | 11820. | 180020. | 1304286. |
| 1971 | 1570. | 976. | 363. | 3764. | 13196. | 199419. | 1428719. |
| 1972 | 1709. | 1080. | 400. | 4149. | 14427. | 218815. | 1587458. |
| 1973 | 1851. | 1186. | 438. | 4536. | 15688. | 238329. | 1749501. |
| 1974 | 1997. | 1295. | 477. | 4923. | 16978. | 257958. | 1913289. |
| 1975 | 2147. | 1407. | 518. | 5311. | 18298. | 277701. | 2079873. |
| 1976 | 2300. | 1522. | 559. | 5699. | 19646. | 297557. | 2248231. |
| 1977 | 2458. | 1640. | 602. | 6087. | 21023. | 317522. | 2418869. |
| 1978 | 2618. | 1761. | 647. | 6475. | 22427. | 337594. | 2591674. |
| 1979 | 2782. | 1884. | 693. | 6862. | 23859. | 357770. | 2766628. |
| 1980 | 2950. | 2010. | 740. | 7250. | 25318. | 378045. | 2943667. |
| 1981 | 3106. | 2124. | 785. | 7571. | 26687. | 397479. | 3122122. |
| 1982 | 3265. | 2240. | 833. | 7889. | 28077. | 416959. | 3302694. |
| 1983 | 3425. | 2357. | 881. | 8203. | 29487. | 436478. | 3485416. |
| 1984 | 3589. | 2476. | 930. | 8513. | 30917. | 456026. | 3670161. |
| 1985 | 3754. | 2597. | 980. | 8818. | 32365. | 475594. | 3856952. |
| 1986 | 3922. | 2719. | 1031. | 9120. | 33831. | 495172. | 4045844. |
| 1987 | 4092. | 2843. | 1084. | 9417. | 35315. | 514747. | 4236626. |
| 1988 | 4264. | 2968. | 1137. | 9709. | 36817. | 534311. | 4429217. |
| 1989 | 4437. | 3093. | 1192. | 9995. | 38336. | 553848. | 4623632. |
| 1990 | 4613. | 3221. | 1247. | 10277. | 39871. | 573350. | 4819793. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
--------

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 176. | 511. | 335. | -21. | 141. | 188. | 228. | 4. |
| 1963 | 472. | 1023. | 681. | -32. | 277. | 406. | 454. | 18. |
| 1964 | 778. | 1642. | 1076. | -14. | 444. | 661. | 731. | 60. |
| 1965 | 1121. | 2311. | 1495. | 19. | 625. | 938. | 1032. | 121. |
| 1966 | 1521. | 2837. | 1860. | 11. | 764. | 1170. | 1262. | 134. |
| 1967 | 1788. | 3070. | 2095. | 73. | 828. | 1323. | 1415. | 239. |
| 1968 | 2075. | 3467. | 2410. | 90. | 938. | 1521. | 1617. | 290. |
| 1969 | 2366. | 3876. | 2735. | 105. | 1053. | 1726. | 1826. | 345. |
| 1970 | 2662. | 4299. | 3070. | 120. | 1173. | 1937. | 2043. | 400. |
| 1971 | 2964. | 4737. | 3416. | 134. | 1299. | 2154. | 2267. | 457. |
| 1972 | 3327. | 5245. | 3781. | 183. | 1426. | 2380. | 2499. | 514. |
| 1973 | 3699. | 5772. | 4157. | 232. | 1557. | 2610. | 2739. | 575. |
| 1974 | 4082. | 6317. | 4545. | 281. | 1693. | 2849. | 2987. | 636. |
| 1975 | 4474. | 6882. | 4946. | 331. | 1837. | 3094. | 3243. | 701. |
| 1976 | 4876. | 7463. | 5360. | 382. | 1985. | 3348. | 3508. | 766. |
| 1977 | 5288. | 8064. | 5785. | 433. | 2138. | 3607. | 3781. | 833. |
| 1978 | 5709. | 8682. | 6221. | 484. | 2297. | 3874. | 4061. | 901. |
| 1979 | 6141. | 9318. | 6670. | 536. | 2463. | 4148. | 4350. | 972. |
| 1980 | 6582. | 9971. | 7128. | 587. | 2633. | 4428. | 4647. | 1043. |
| 1981 | 6977. | 10627. | 7587. | 636. | 2801. | 4701. | 4927. | 1108. |
| 1982 | 7377. | 11300. | 8055. | 685. | 2975. | 4980. | 5213. | 1173. |
| 1983 | 7783. | 11987. | 8532. | 733. | 3154. | 5264. | 5506. | 1240. |
| 1984 | 8194. | 12689. | 9017. | 782. | 3338. | 5553. | 5806. | 1308. |
| 1985 | 8610. | 13405. | 9512. | 830. | 3525. | 5847. | 6111. | 1376. |
| 1986 | 9029. | 14134. | 10014. | 880. | 3718. | 6146. | 6422. | 1445. |
| 1987 | 9451. | 14877. | 10524. | 928. | 3915. | 6450. | 6739. | 1514. |
| 1988 | 9877. | 15634. | 11042. | 976. | 4117. | 6759. | 7062. | 1585. |
| 1989 | 10305. | 16403. | 11566. | 1025. | 4323. | 7071. | 7390. | 1656. |
| 1990 | 10734. | 17185. | 12098. | 1074. | 4534. | 7388. | 7723. | 1727. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING ANC OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 36. | 63. | 52. | 1001. | 19. |
| 1963 | 54. | 45. | 86. | 65. | 102. | 1697. | 117. |
| 1964 | 85. | 74. | 135. | 84. | 156. | 2389. | 215. |
| 1965 | 118. | 107. | 170. | 157. | 220. | 3077. | 315. |
| 1966 | 151. | 136. | 226. | 290. | 294. | 3756. | 419. |
| 1967 | 181. | 174. | 264. | 258. | 339. | 4430. | 518. |
| 1968 | 214. | 209. | 314. | 302. | 399. | 5100. | 618. |
| 1969 | 247. | 244. | 364. | 347. | 460. | 5763. | 718. |
| 1970 | 282. | 282. | 416. | 396. | 522. | 6422. | 820. |
| 1971 | 318. | 320. | 470. | 445. | 586. | 7076. | 922. |
| 1972 | 355. | 360. | 524. | 483. | 652. | 7726. | 1028. |
| 1973 | 393. | 401. | 581. | 520. | 719. | 8371. | 1134. |
| 1974 | 433. | 443. | 637. | 561. | 787. | 9012. | 1242. |
| 1975 | 474. | 486. | 696. | 602. | 857. | 9647. | 1352. |
| 1976 | 516. | 530. | 756. | 644. | 928. | 10276. | 1461. |
| 1977 | 560. | 575. | 817. | 688. | 1001. | 10900. | 1573. |
| 1978 | 605. | 623. | 880. | 732. | 1075. | 11518. | 1684. |
| 1979 | 650. | 670. | 943. | 778. | 1150. | 12128. | 1798. |
| 1980 | 697. | 719. | 1008. | 825. | 1226. | 12730. | 1912. |
| 1981 | 731. | 753. | 1056. | 866. | 1284. | 13307. | 2020. |
| 1982 | 767. | 789. | 1106. | 909. | 1343. | 13876. | 2129. |
| 1983 | 801. | 824. | 1155. | 950. | 1401. | 14431. | 2239. |
| 1984 | 837. | 859. | 1206. | 993. | 1460. | 14976. | 2348. |
| 1985 | 873. | 895. | 1255. | 1036. | 1519. | 15505. | 2457. |
| 1986 | 909. | 930. | 1305. | 1078. | 1577. | 16021. | 2565. |
| 1987 | 945. | 967. | 1355. | 1121. | 1636. | 16522. | 2673. |
| 1988 | 981. | 1002. | 1404. | 1163. | 1695. | 17008. | 2780. |
| 1989 | 1018. | 1037. | 1453. | 1204. | 1754. | 17476. | 2887. |
| 1990 | 1054. | 1073. | 1502. | 1245. | 1812. | 17928. | 2992. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: LOW(ESTIMATE 1)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | ACTUARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | 0. | 0. |
| 1962 | 109. | 66. | 25. | 374. | 1017. | 22403. | 143966. |
| 1963 | 248. | 159. | 58. | 742. | 2273. | 42170. | 284404. |
| 1964 | 406. | 261. | 96. | 1112. | 3651. | 63088. | 434400. |
| 1965 | 575. | 368. | 136. | 1484. | 5011. | 84593. | 621051. |
| 1966 | 726. | 464. | 171. | 1860. | 6587. | 105302. | 823134. |
| 1967 | 837. | 537. | 195. | 2236. | 7579. | 122999. | 913872. |
| 1968 | 976. | 627. | 226. | 2614. | 8832. | 142203. | 1040690. |
| 1969 | 1121. | 718. | 257. | 2996. | 10124. | 161554. | 1170468. |
| 1970 | 1271. | 813. | 290. | 3378. | 11456. | 181053. | 1301744. |
| 1971 | 1426. | 910. | 324. | 3763. | 12829. | 200696. | 1427204. |
| 1972 | 1561. | 1010. | 358. | 4149. | 14053. | 220060. | 1587067. |
| 1973 | 1700. | 1112. | 394. | 4535. | 15305. | 239537. | 1750271. |
| 1974 | 1842. | 1217. | 430. | 4922. | 16587. | 259126. | 1915259. |
| 1975 | 1988. | 1325. | 469. | 5311. | 17897. | 278824. | 2083081. |
| 1976 | 2137. | 1436. | 508. | 5699. | 19236. | 298632. | 2252714. |
| 1977 | 2291. | 1550. | 549. | 6087. | 20603. | 318544. | 2424666. |
| 1978 | 2447. | 1665. | 590. | 6475. | 21997. | 338561. | 2598824. |
| 1979 | 2606. | 1784. | 634. | 6862. | 23418. | 358677. | 2775168. |
| 1980 | 2770. | 1904. | 678. | 7250. | 24866. | 378889. | 2953637. |
| 1981 | 2921. | 2013. | 721. | 7571. | 26224. | 398257. | 3133564. |
| 1982 | 3074. | 2124. | 765. | 7889. | 27603. | 417666. | 3315649. |
| 1983 | 3230. | 2235. | 810. | 8204. | 29000. | 437111. | 3499928. |
| 1984 | 3388. | 2348. | 856. | 8513. | 30417. | 456581. | 3686274. |
| 1985 | 3548. | 2462. | 903. | 8819. | 31852. | 476068. | 3874713. |
| 1986 | 3710. | 2579. | 950. | 9121. | 33305. | 495562. | 4065301. |
| 1987 | 3874. | 2695. | 1000. | 9418. | 34776. | 515050. | 4257830. |
| 1988 | 4040. | 2813. | 1049. | 9710. | 36264. | 534522. | 4452218. |
| 1989 | 4206. | 2932. | 1101. | 9997. | 37769. | 553964. | 4648486. |
| 1990 | 4375. | 3051. | 1151. | 10279. | 39290. | 573367. | 4846557. |

Table I-22

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
--------

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 176. | 600. | 376. | -21. | 112. | 206. | 202. | 3. |
| 1963 | 466. | 1282. | 780. | -35. | 162. | 448. | 360. | 16. |
| 1964 | 778. | 2019. | 1228. | -15. | 287. | 745. | 618. | 57. |
| 1965 | 1105. | 2783. | 1710. | 22. | 368. | 1067. | 843. | 118. |
| 1966 | 1513. | 3509. | 2163. | 16. | 481. | 1337. | 1052. | 130. |
| 1967 | 1760. | 3757. | 2338. | 84. | 517. | 1446. | 1207. | 235. |
| 1968 | 2043. | 4191. | 2677. | 105. | 615. | 1660. | 1421. | 287. |
| 1969 | 2330. | 4641. | 3028. | 124. | 716. | 1882. | 1643. | 341. |
| 1970 | 2621. | 5110. | 3392. | 144. | 820. | 2112. | 1873. | 396. |
| 1971 | 2918. | 5597. | 3768. | 162. | 929. | 2349. | 2113. | 454. |
| 1972 | 3282. | 6170. | 4170. | 212. | 1061. | 2596. | 2361. | 511. |
| 1973 | 3654. | 6765. | 4586. | 261. | 1200. | 2849. | 2618. | 572. |
| 1974 | 4037. | 7384. | 5016. | 311. | 1343. | 3112. | 2885. | 634. |
| 1975 | 4430. | 8025. | 5461. | 361. | 1495. | 3383. | 3161. | 698. |
| 1976 | 4832. | 8689. | 5922. | 413. | 1652. | 3664. | 3448. | 763. |
| 1977 | 5246. | 9376. | 6397. | 465. | 1815. | 3953. | 3743. | 831. |
| 1978 | 5668. | 10086. | 6885. | 517. | 1985. | 4250. | 4049. | 899. |
| 1979 | 6101. | 10819. | 7390. | 570. | 2162. | 4557. | 4363. | 970. |
| 1980 | 6543. | 11575. | 7908. | 622. | 2345. | 4872. | 4689. | 1042. |
| 1981 | 6939. | 12340. | 8429. | 671. | 2527. | 5182. | 4999. | 1107. |
| 1982 | 7341. | 13128. | 8963. | 721. | 2716. | 5500. | 5317. | 1173. |
| 1983 | 7750. | 13937. | 9510. | 771. | 2911. | 5825. | 5644. | 1240. |
| 1984 | 8162. | 14767. | 10069. | 820. | 3112. | 6158. | 5980. | 1308. |
| 1985 | 8581. | 15619. | 10642. | 869. | 3319. | 6498. | 6323. | 1376. |
| 1986 | 9002. | 16492. | 11225. | 920. | 3532. | 6846. | 6675. | 1446. |
| 1987 | 9428. | 17386. | 11822. | 969. | 3751. | 7201. | 7036. | 1516. |
| 1988 | 9857. | 18303. | 12431. | 1019. | 3976. | 7563. | 7406. | 1587. |
| 1989 | 10288. | 19241. | 13050. | 1069. | 4207. | 7933. | 7783. | 1659. |
| 1990 | 10722. | 20201. | 13682. | 1118. | 4445. | 8309. | 8169. | 1730. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
--------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 35. | 63. | 50. | 1002. | 20. |
| 1963 | 55. | 44. | 84. | 65. | 97. | 1699. | 118. |
| 1964 | 87. | 74. | 131. | 83. | 151. | 2390. | 218. |
| 1965 | 120. | 107. | 164. | 156. | 210. | 3079. | 320. |
| 1966 | 155. | 135. | 219. | 290. | 283. | 3758. | 426. |
| 1967 | 184. | 173. | 259. | 257. | 328. | 4434. | 524. |
| 1968 | 217. | 208. | 309. | 302. | 388. | 5104. | 625. |
| 1969 | 251. | 244. | 360. | 347. | 449. | 5768. | 727. |
| 1970 | 287. | 282. | 412. | 396. | 511. | 6427. | 830. |
| 1971 | 323. | 320. | 466. | 446. | 575. | 7083. | 933. |
| 1972 | 361. | 360. | 521. | 483. | 641. | 7733. | 1039. |
| 1973 | 401. | 401. | 578. | 521. | 708. | 8379. | 1146. |
| 1974 | 441. | 443. | 636. | 562. | 776. | 9021. | 1254. |
| 1975 | 484. | 486. | 695. | 603. | 847. | 9657. | 1364. |
| 1976 | 526. | 530. | 756. | 645. | 918. | 10287. | 1474. |
| 1977 | 571. | 576. | 818. | 690. | 991. | 10913. | 1586. |
| 1978 | 617. | 623. | 882. | 735. | 1065. | 11532. | 1698. |
| 1979 | 664. | 671. | 946. | 781. | 1141. | 12143. | 1812. |
| 1980 | 712. | 719. | 1012. | 828. | 1217. | 12747. | 1926. |
| 1981 | 748. | 754. | 1062. | 870. | 1276. | 13326. | 2036. |
| 1982 | 785. | 790. | 1113. | 913. | 1335. | 13895. | 2145. |
| 1983 | 821. | 825. | 1163. | 955. | 1394. | 14452. | 2255. |
| 1984 | 858. | 861. | 1215. | 998. | 1453. | 14999. | 2365. |
| 1985 | 896. | 897. | 1266. | 1041. | 1512. | 15530. | 2474. |
| 1986 | 934. | 932. | 1318. | 1084. | 1571. | 16048. | 2583. |
| 1987 | 971. | 968. | 1369. | 1127. | 1632. | 16551. | 2692. |
| 1988 | 1010. | 1004. | 1420. | 1169. | 1691. | 17039. | 2800. |
| 1989 | 1049. | 1039. | 1472. | 1211. | 1751. | 17510. | 2907. |
| 1990 | 1087. | 1075. | 1523. | 1253. | 1810. | 17964. | 3013. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | ACTUARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | 0. | 0. |
| 1962 | 132. | 80. | 33. | 374. | 1059. | 22245. | 143703. |
| 1963 | 305. | 189. | 77. | 743. | 2402. | 41879. | 283751. |
| 1964 | 474. | 291. | 115. | 1113. | 3841. | 62847. | 436439. |
| 1965 | 674. | 410. | 164. | 1485. | 5239. | 84083. | 622869. |
| 1966 | 839. | 506. | 198. | 1861. | 6959. | 105372. | 828090. |
| 1967 | 961. | 590. | 227. | 2236. | 7933. | 122626. | 918613. |
| 1968 | 1112. | 685. | 261. | 2615. | 9230. | 141935. | 1049164. |
| 1969 | 1269. | 783. | 296. | 2997. | 10569. | 161410. | 1182661. |
| 1970 | 1431. | 885. | 333. | 3380. | 11954. | 181052. | 1317620. |
| 1971 | 1600. | 989. | 370. | 3764. | 13384. | 200860. | 1446709. |
| 1972 | 1747. | 1098. | 409. | 4150. | 14671. | 220687. | 1610688. |
| 1973 | 1899. | 1208. | 449. | 4537. | 15991. | 240663. | 1778299. |
| 1974 | 2054. | 1322. | 490. | 4924. | 17346. | 260790. | 1948005. |
| 1975 | 2214. | 1439. | 533. | 5313. | 18734. | 281065. | 2120875. |
| 1976 | 2378. | 1560. | 578. | 5701. | 20155. | 301491. | 2295910. |
| 1977 | 2547. | 1684. | 624. | 6090. | 21611. | 322065. | 2473639. |
| 1978 | 2720. | 1810. | 671. | 6478. | 23098. | 342790. | 2653973. |
| 1979 | 2897. | 1940. | 720. | 6866. | 24619. | 363662. | 2836918. |
| 1980 | 3079. | 2073. | 771. | 7253. | 26173. | 384681. | 3022438. |
| 1981 | 3249. | 2194. | 820. | 7575. | 27644. | 404908. | 3209893. |
| 1982 | 3423. | 2318. | 872. | 7894. | 29142. | 425232. | 3400011. |
| 1983 | 3601. | 2444. | 924. | 8208. | 30666. | 445650. | 3592858. |
| 1984 | 3781. | 2572. | 978. | 8518. | 32218. | 466154. | 3788336. |
| 1985 | 3965. | 2702. | 1033. | 8825. | 33795. | 486739. | 3986505. |
| 1986 | 4152. | 2835. | 1089. | 9127. | 35399. | 507397. | 4187452. |
| 1987 | 4343. | 2969. | 1147. | 9424. | 37029. | 528119. | 4391005. |
| 1988 | 4537. | 3105. | 1207. | 9717. | 38686. | 548900. | 4597120. |
| 1989 | 4733. | 3243. | 1268. | 10004. | 40368. | 569727. | 4805852. |
| 1990 | 4934. | 3383. | 1329. | 10287. | 42078. | 590597. | 5017166. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
--------

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 176. | 511. | 335. | -21. | 141. | 188. | 228. | 4. |
| 1963 | 472. | 1023. | 681. | -32. | 277. | 406. | 454. | 18. |
| 1964 | 778. | 1642. | 1076. | -14. | 444. | 661. | 731. | 60. |
| 1965 | 1121. | 2311. | 1495. | 19. | 625. | 938. | 1032. | 121. |
| 1966 | 1521. | 2837. | 1860. | 11. | 764. | 1170. | 1262. | 134. |
| 1967 | 1788. | 3070. | 2095. | 73. | 828. | 1323. | 1415. | 239. |
| 1968 | 2079. | 3499. | 2424. | 90. | 947. | 1531. | 1630. | 291. |
| 1969 | 2374. | 3943. | 2765. | 106. | 1073. | 1747. | 1853. | 345. |
| 1970 | 2674. | 4403. | 3117. | 121. | 1203. | 1969. | 2083. | 400. |
| 1971 | 2981. | 4880. | 3480. | 135. | 1340. | 2199. | 2324. | 458. |
| 1972 | 3349. | 5430. | 3864. | 183. | 1479. | 2438. | 2572. | 515. |
| 1973 | 3727. | 6003. | 4261. | 233. | 1624. | 2683. | 2830. | 576. |
| 1974 | 4116. | 6597. | 4672. | 282. | 1775. | 2937. | 3097. | 638. |
| 1975 | 4514. | 7213. | 5096. | 332. | 1933. | 3199. | 3374. | 703. |
| 1976 | 4922. | 7850. | 5534. | 383. | 2097. | 3470. | 3661. | 768. |
| 1977 | 5342. | 8510. | 5986. | 434. | 2267. | 3748. | 3957. | 835. |
| 1978 | 5770. | 9191. | 6451. | 486. | 2445. | 4035. | 4262. | 904. |
| 1979 | 6210. | 9894. | 6930. | 538. | 2630. | 4330. | 4577. | 975. |
| 1980 | 6659. | 10619. | 7420. | 590. | 2821. | 4633. | 4903. | 1046. |
| 1981 | 7063. | 11351. | 7913. | 639. | 3011. | 4930. | 5213. | 1112. |
| 1982 | 7473. | 12104. | 8418. | 688. | 3208. | 5234. | 5531. | 1178. |
| 1983 | 7890. | 12877. | 8934. | 737. | 3412. | 5546. | 5857. | 1245. |
| 1984 | 8311. | 13670. | 9460. | 786. | 3622. | 5863. | 6193. | 1313. |
| 1985 | 8739. | 14483. | 9999. | 834. | 3838. | 6188. | 6536. | 1381. |
| 1986 | 9170. | 15315. | 10547. | 884. | 4061. | 6520. | 6888. | 1451. |
| 1987 | 9606. | 16166. | 11106. | 933. | 4289. | 6858. | 7248. | 1521. |
| 1988 | 10045. | 17038. | 11676. | 981. | 4524. | 7203. | 7617. | 1593. |
| 1989 | 10487. | 17929. | 12255. | 1031. | 4766. | 7554. | 7993. | 1665. |
| 1990 | 10933. | 18841. | 12845. | 1080. | 5014. | 7912. | 8377. | 1736. |

Table I-22

PROJECTED REQUIRED MANPOWER INFLOWS

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI- NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 36. | 63. | 52. | 1001. | 19. |
| 1963 | 54. | 45. | 86. | 65. | 102. | 1697. | 117. |
| 1964 | 85. | 74. | 135. | 84. | 156. | 2389. | 215. |
| 1965 | 118. | 107. | 170. | 157. | 220. | 3077. | 315. |
| 1966 | 151. | 136. | 226. | 290. | 294. | 3756. | 419. |
| 1967 | 181. | 174. | 264. | 258. | 339. | 4430. | 518. |
| 1968 | 214. | 209. | 315. | 302. | 399. | 5100. | 618. |
| 1969 | 247. | 244. | 365. | 347. | 461. | 5764. | 718. |
| 1970 | 283. | 282. | 418. | 396. | 523. | 6423. | 820. |
| 1971 | 319. | 320. | 471. | 446. | 588. | 7078. | 922. |
| 1972 | 357. | 360. | 526. | 483. | 654. | 7728. | 1028. |
| 1973 | 396. | 401. | 583. | 520. | 722. | 8373. | 1134. |
| 1974 | 436. | 444. | 640. | 561. | 791. | 9015. | 1243. |
| 1975 | 478. | 487. | 700. | 602. | 861. | 9651. | 1352. |
| 1976 | 520. | 531. | 760. | 644. | 933. | 10280. | 1462. |
| 1977 | 565. | 576. | 822. | 689. | 1007. | 10906. | 1573. |
| 1978 | 610. | 624. | 885. | 733. | 1081. | 11524. | 1685. |
| 1979 | 656. | 672. | 949. | 779. | 1158. | 12134. | 1799. |
| 1980 | 704. | 720. | 1014. | 826. | 1235. | 12738. | 1912. |
| 1981 | 740. | 755. | 1064. | 868. | 1294. | 13316. | 2021. |
| 1982 | 776. | 791. | 1114. | 910. | 1353. | 13885. | 2130. |
| 1983 | 812. | 826. | 1164. | 952. | 1413. | 14441. | 2240. |
| 1984 | 849. | 862. | 1216. | 995. | 1473. | 14987. | 2349. |
| 1985 | 886. | 898. | 1266. | 1038. | 1533. | 15518. | 2458. |
| 1986 | 923. | 933. | 1317. | 1080. | 1592. | 16035. | 2566. |
| 1987 | 960. | 970. | 1368. | 1123. | 1653. | 16537. | 2674. |
| 1988 | 997. | 1005. | 1418. | 1165. | 1713. | 17024. | 2782. |
| 1989 | 1036. | 1041. | 1469. | 1207. | 1774. | 17494. | 2888. |
| 1990 | 1073. | 1076. | 1519. | 1249. | 1834. | 17947. | 2994. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: MEDIUM(ESTIMATE 2)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
--------

| YEAR | ACTUARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | 0. | 0. |
| 1962 | 109. | 66. | 25. | 374. | 1017. | 22403. | 143966. |
| 1963 | 248. | 159. | 58. | 742. | 2273. | 42170. | 284404. |
| 1964 | 406. | 261. | 96. | 1112. | 3651. | 63088. | 434400. |
| 1965 | 575. | 368. | 136. | 1484. | 5011. | 84593. | 621051. |
| 1966 | 726. | 464. | 171. | 1860. | 6587. | 105302. | 823134. |
| 1967 | 837. | 537. | 195. | 2236. | 7579. | 122999. | 913872. |
| 1968 | 981. | 629. | 227. | 2614. | 8870. | 142509. | 1044883. |
| 1969 | 1132. | 724. | 260. | 2996. | 10202. | 162196. | 1178989. |
| 1970 | 1288. | 822. | 294. | 3379. | 11581. | 182059. | 1314723. |
| 1971 | 1450. | 922. | 329. | 3764. | 13004. | 202098. | 1444770. |
| 1972 | 1592. | 1026. | 365. | 4150. | 14280. | 221877. | 1609847. |
| 1973 | 1739. | 1132. | 403. | 4537. | 15588. | 241800. | 1778633. |
| 1974 | 1890. | 1241. | 441. | 4924. | 16929. | 261865. | 1949589. |
| 1975 | 2045. | 1354. | 481. | 5313. | 18303. | 282073. | 2123787. |
| 1976 | 2203. | 1469. | 522. | 5701. | 19710. | 302423. | 2300226. |
| 1977 | 2367. | 1588. | 565. | 6090. | 21149. | 322915. | 2479438. |
| 1978 | 2534. | 1709. | 609. | 6478. | 22620. | 343549. | 2661333. |
| 1979 | 2704. | 1833. | 655. | 6866. | 24123. | 364323. | 2845918. |
| 1980 | 2880. | 1960. | 702. | 7253. | 25658. | 385235. | 3033159. |
| 1981 | 3044. | 2075. | 747. | 7575. | 27110. | 405347. | 3222417. |
| 1982 | 3211. | 2193. | 795. | 7894. | 28587. | 425548. | 3414421. |
| 1983 | 3382. | 2312. | 843. | 8209. | 30090. | 445834. | 3609239. |
| 1984 | 3555. | 2433. | 892. | 8519. | 31618. | 466197. | 3806775. |
| 1985 | 3732. | 2555. | 943. | 8825. | 33171. | 486632. | 4007092. |
| 1986 | 3911. | 2680. | 994. | 9127. | 34750. | 507131. | 4210279. |
| 1987 | 4093. | 2806. | 1047. | 9425. | 36354. | 527685. | 4416166. |
| 1988 | 4279. | 2934. | 1101. | 9717. | 37983. | 548287. | 4624713. |
| 1989 | 4466. | 3063. | 1157. | 10005. | 39637. | 568926. | 4835978. |
| 1990 | 4657. | 3194. | 1212. | 10288. | 41316. | 589596. | 5049930. |

Table I-22

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 176. | 600. | 376. | -21. | 112. | 206. | 202. | 3. |
| 1963 | 466. | 1282. | 780. | -35. | 162. | 448. | 360. | 16. |
| 1964 | 778. | 2019. | 1228. | -15. | 287. | 745. | 618. | 57. |
| 1965 | 1105. | 2783. | 1710. | 22. | 368. | 1067. | 843. | 118. |
| 1966 | 1513. | 3509. | 2163. | 16. | 481. | 1337. | 1052. | 130. |
| 1967 | 1760. | 3757. | 2338. | 84. | 517. | 1446. | 1207. | 235. |
| 1968 | 2047. | 4230. | 2694. | 105. | 623. | 1672. | 1432. | 287. |
| 1969 | 2338. | 4724. | 3063. | 125. | 733. | 1908. | 1666. | 342. |
| 1970 | 2634. | 5239. | 3446. | 144. | 847. | 2151. | 1909. | 397. |
| 1971 | 2936. | 5776. | 3844. | 163. | 966. | 2404. | 2163. | 454. |
| 1972 | 3305. | 6403. | 4270. | 213. | 1110. | 2668. | 2426. | 512. |
| 1973 | 3683. | 7056. | 4711. | 263. | 1261. | 2940. | 2701. | 573. |
| 1974 | 4072. | 7737. | 5168. | 313. | 1418. | 3223. | 2985. | 635. |
| 1975 | 4471. | 8446. | 5643. | 364. | 1583. | 3516. | 3281. | 700. |
| 1976 | 4880. | 9182. | 6136. | 416. | 1756. | 3820. | 3588. | 766. |
| 1977 | 5301. | 9946. | 6647. | 468. | 1936. | 4134. | 3906. | 834. |
| 1978 | 5731. | 10739. | 7173. | 521. | 2124. | 4458. | 4235. | 902. |
| 1979 | 6173. | 11561. | 7719. | 574. | 2321. | 4794. | 4575. | 974. |
| 1980 | 6624. | 12412. | 8281. | 627. | 2524. | 5140. | 4928. | 1046. |
| 1981 | 7030. | 13279. | 8850. | 677. | 2729. | 5483. | 5268. | 1112. |
| 1982 | 7442. | 14175. | 9435. | 727. | 2941. | 5838. | 5617. | 1178. |
| 1983 | 7861. | 15100. | 10037. | 777. | 3162. | 6202. | 5977. | 1245. |
| 1984 | 8285. | 16054. | 10655. | 828. | 3390. | 6576. | 6349. | 1314. |
| 1985 | 8716. | 17037. | 11291. | 877. | 3626. | 6961. | 6730. | 1383. |
| 1986 | 9151. | 18051. | 11943. | 929. | 3870. | 7356. | 7123. | 1454. |
| 1987 | 9590. | 19095. | 12612. | 979. | 4122. | 7762. | 7528. | 1524. |
| 1988 | 10034. | 20172. | 13299. | 1029. | 4382. | 8179. | 7943. | 1597. |
| 1989 | 10481. | 21281. | 14002. | 1080. | 4651. | 8606. | 8369. | 1669. |
| 1990 | 10932. | 22422. | 14723. | 1131. | 4928. | 9045. | 8807. | 1741. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

--------

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI- NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 35. | 63. | 50. | 1002. | 20. |
| 1963 | 55. | 44. | 84. | 65. | 97. | 1699. | 118. |
| 1964 | 87. | 74. | 131. | 83. | 151. | 2390. | 218. |
| 1965 | 120. | 107. | 164. | 156. | 210. | 3079. | 320. |
| 1966 | 155. | 135. | 219. | 290. | 283. | 3758. | 426. |
| 1967 | 184. | 173. | 259. | 257. | 328. | 4434. | 524. |
| 1968 | 218. | 208. | 309. | 302. | 388. | 5104. | 625. |
| 1969 | 252. | 244. | 360. | 347. | 449. | 5768. | 727. |
| 1970 | 288. | 282. | 413. | 396. | 512. | 6428. | 830. |
| 1971 | 326. | 320. | 467. | 446. | 576. | 7084. | 934. |
| 1972 | 364. | 360. | 522. | 484. | 642. | 7735. | 1040. |
| 1973 | 404. | 401. | 579. | 521. | 710. | 8381. | 1147. |
| 1974 | 445. | 444. | 637. | 562. | 778. | 9024. | 1256. |
| 1975 | 488. | 487. | 697. | 604. | 849. | 9660. | 1366. |
| 1976 | 532. | 531. | 758. | 646. | 921. | 10291. | 1476. |
| 1977 | 578. | 577. | 820. | 691. | 995. | 10917. | 1588. |
| 1978 | 625. | 624. | 884. | 736. | 1069. | 11537. | 1700. |
| 1979 | 672. | 672. | 949. | 782. | 1145. | 12148. | 1815. |
| 1980 | 722. | 721. | 1015. | 829. | 1222. | 12753. | 1929. |
| 1981 | 759. | 756. | 1065. | 871. | 1281. | 13333. | 2039. |
| 1982 | 798. | 792. | 1116. | 914. | 1341. | 13903. | 2148. |
| 1983 | 835. | 827. | 1167. | 956. | 1400. | 14461. | 2259. |
| 1984 | 874. | 863. | 1219. | 1000. | 1460. | 15008. | 2369. |
| 1985 | 914. | 900. | 1271. | 1043. | 1521. | 15541. | 2479. |
| 1986 | 954. | 935. | 1323. | 1086. | 1580. | 16060. | 2587. |
| 1987 | 993. | 972. | 1375. | 1129. | 1642. | 16564. | 2697. |
| 1988 | 1034. | 1008. | 1427. | 1172. | 1702. | 17053. | 2805. |
| 1989 | 1075. | 1043. | 1478. | 1214. | 1763. | 17525. | 2912. |
| 1990 | 1115. | 1080. | 1531. | 1257. | 1823. | 17981. | 3018. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MFG. IND. PROJECTED BY SUB-SECTOR)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
--------

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | 0. | 0. |
| 1962 | 132. | 80. | 33. | 374. | 1059. | 22245. | 143703. |
| 1963 | 305. | 189. | 77. | 743. | 2402. | 41879. | 283751. |
| 1964 | 474. | 291. | 115. | 1113. | 3841. | 62847. | 436439. |
| 1965 | 674. | 410. | 164. | 1485. | 5239. | 84083. | 622869. |
| 1966 | 839. | 506. | 198. | 1861. | 6959. | 105372. | 828090. |
| 1967 | 961. | 590. | 227. | 2236. | 7933. | 122626. | 918613. |
| 1968 | 1118. | 689. | 262. | 2615. | 9270. | 142249. | 1053492. |
| 1969 | 1282. | 790. | 299. | 2997. | 10654. | 162072. | 1191503. |
| 1970 | 1452. | 895. | 338. | 3380. | 12089. | 182096. | 1331154. |
| 1971 | 1630. | 1004. | 377. | 3765. | 13575. | 202326. | 1465106. |
| 1972 | 1786. | 1116. | 417. | 4151. | 14921. | 222602. | 1634604. |
| 1973 | 1948. | 1231. | 460. | 4538. | 16305. | 243066. | 1808142. |
| 1974 | 2114. | 1350. | 503. | 4926. | 17728. | 263719. | 1984204. |
| 1975 | 2285. | 1472. | 550. | 5315. | 19189. | 284564. | 2163885. |
| 1976 | 2461. | 1599. | 597. | 5704. | 20690. | 305606. | 2346209. |
| 1977 | 2643. | 1729. | 646. | 6092. | 22231. | 326843. | 2531733. |
| 1978 | 2829. | 1862. | 697. | 6481. | 23811. | 348283. | 2720399. |
| 1979 | 3021. | 1999. | 750. | 6869. | 25431. | 369925. | 2912244. |
| 1980 | 3218. | 2139. | 805. | 7257. | 27091. | 391771. | 3107265. |
| 1981 | 3405. | 2269. | 858. | 7579. | 28676. | 412887. | 3304862. |
| 1982 | 3597. | 2401. | 914. | 7898. | 30297. | 434166. | 3505799. |
| 1983 | 3793. | 2537. | 972. | 8214. | 31953. | 455606. | 3710184. |
| 1984 | 3993. | 2674. | 1030. | 8524. | 33645. | 477208. | 3917964. |
| 1985 | 4199. | 2815. | 1091. | 8831. | 35373. | 498967. | 4129244. |
| 1986 | 4408. | 2959. | 1154. | 9134. | 37137. | 520883. | 4344162. |
| 1987 | 4623. | 3105. | 1218. | 9432. | 38939. | 542949. | 4562597. |
| 1988 | 4843. | 3254. | 1285. | 9726. | 40779. | 565165. | 4784558. |
| 1989 | 5066. | 3405. | 1353. | 10014. | 42658. | 587526. | 5010160. |
| 1990 | 5296. | 3560. | 1423. | 10298. | 44577. | 610032. | 5239428. |

Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | CIVIL ENG. | MECH+IND. ENGINEERS | ELECT. ENG. | MINING ENG. | CHEMICAL ENGINEERS | PROF.ENG. (N.E.S.) | CHEMISTS | GEOLOGISTS |
|---|---|---|---|---|---|---|---|---|
| 1961 | -0. | 0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 176. | 511. | 335. | -21. | 141. | 188. | 228. | 4. |
| 1963 | 472. | 1023. | 681. | -32. | 277. | 406. | 454. | 18. |
| 1964 | 778. | 1642. | 1076. | -14. | 444. | 661. | 731. | 60. |
| 1965 | 1121. | 2311. | 1495. | 19. | 625. | 938. | 1032. | 121. |
| 1966 | 1521. | 2837. | 1860. | 11. | 764. | 1170. | 1262. | 134. |
| 1967 | 1788. | 3070. | 2095. | 73. | 828. | 1323. | 1415. | 239. |
| 1968 | 2083. | 3532. | 2439. | 90. | 957. | 1542. | 1643. | 291. |
| 1969 | 2382. | 4011. | 2795. | 106. | 1092. | 1768. | 1879. | 345. |
| 1970 | 2687. | 4508. | 3164. | 121. | 1233. | 2002. | 2125. | 401. |
| 1971 | 2998. | 5025. | 3546. | 135. | 1382. | 2245. | 2381. | 458. |
| 1972 | 3372. | 5620. | 3950. | 184. | 1534. | 2498. | 2647. | 517. |
| 1973 | 3755. | 6239. | 4368. | 233. | 1693. | 2758. | 2923. | 577. |
| 1974 | 4150. | 6884. | 4801. | 283. | 1858. | 3028. | 3211. | 640. |
| 1975 | 4555. | 7556. | 5251. | 333. | 2032. | 3308. | 3509. | 704. |
| 1976 | 4970. | 8252. | 5716. | 384. | 2214. | 3597. | 3820. | 770. |
| 1977 | 5398. | 8975. | 6196. | 436. | 2402. | 3896. | 4140. | 838. |
| 1978 | 5834. | 9725. | 6692. | 488. | 2600. | 4204. | 4473. | 907. |
| 1979 | 6283. | 10502. | 7204. | 540. | 2806. | 4522. | 4817. | 978. |
| 1980 | 6742. | 11305. | 7730. | 592. | 3020. | 4850. | 5174. | 1050. |
| 1981 | 7156. | 12121. | 8261. | 641. | 3234. | 5173. | 5517. | 1116. |
| 1982 | 7576. | 12965. | 8806. | 691. | 3458. | 5506. | 5871. | 1182. |
| 1983 | 8005. | 13834. | 9365. | 740. | 3690. | 5848. | 6235. | 1250. |
| 1984 | 8438. | 14730. | 9938. | 789. | 3930. | 6199. | 6612. | 1319. |
| 1985 | 8879. | 15652. | 10527. | 838. | 4177. | 6558. | 6998. | 1388. |
| 1986 | 9324. | 16602. | 11127. | 889. | 4434. | 6927. | 7396. | 1458. |
| 1987 | 9775. | 17578. | 11743. | 938. | 4699. | 7305. | 7806. | 1529. |
| 1988 | 10230. | 18584. | 12374. | 987. | 4973. | 7692. | 8227. | 1601. |
| 1989 | 10690. | 19618. | 13017. | 1037. | 5256. | 8089. | 8660. | 1674. |
| 1990 | 11153. | 20681. | 13676. | 1086. | 5548. | 8494. | 9104. | 1746. |



Table I-22

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT

| YEAR | PHYSICISTS | PHYSICAL SCIENTISTS (N.E.S.) | BIOLOGICAL SCIENTISTS | VETERI-NARIANS | AGRI. PROF. (N.E.S.) | PHYSICIANS AND SURG. | ARCHITECTS |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 1962 | 25. | 17. | 36. | 63. | 52. | 1001. | 19. |
| 1963 | 54. | 45. | 86. | 65. | 102. | 1697. | 117. |
| 1964 | 85. | 74. | 135. | 84. | 156. | 2389. | 215. |
| 1965 | 118. | 107. | 170. | 157. | 220. | 3077. | 315. |
| 1966 | 151. | 136. | 226. | 290. | 294. | 3756. | 419. |
| 1967 | 181. | 174. | 264. | 258. | 339. | 4430. | 518. |
| 1968 | 214. | 209. | 315. | 302. | 400. | 5100. | 618. |
| 1969 | 248. | 245. | 366. | 347. | 462. | 5765. | 719. |
| 1970 | 284. | 283. | 419. | 396. | 525. | 6424. | 820. |
| 1971 | 321. | 321. | 473. | 446. | 590. | 7080. | 923. |
| 1972 | 359. | 361. | 528. | 483. | 657. | 7730. | 1028. |
| 1973 | 399. | 402. | 585. | 521. | 725. | 8376. | 1134. |
| 1974 | 439. | 444. | 643. | 562. | 795. | 9018. | 1243. |
| 1975 | 482. | 488. | 703. | 603. | 866. | 9655. | 1352. |
| 1976 | 525. | 532. | 764. | 645. | 938. | 10285. | 1462. |
| 1977 | 570. | 578. | 827. | 690. | 1013. | 10911. | 1574. |
| 1978 | 617. | 625. | 890. | 734. | 1088. | 11530. | 1685. |
| 1979 | 663. | 673. | 955. | 780. | 1166. | 12141. | 1799. |
| 1980 | 712. | 722. | 1021. | 828. | 1244. | 12746. | 1913. |
| 1981 | 749. | 757. | 1072. | 869. | 1304. | 13325. | 2022. |
| 1982 | 786. | 793. | 1123. | 912. | 1364. | 13895. | 2131. |
| 1983 | 823. | 828. | 1174. | 954. | 1425. | 14452. | 2241. |
| 1984 | 861. | 864. | 1226. | 997. | 1486. | 14999. | 2350. |
| 1985 | 899. | 901. | 1278. | 1040. | 1548. | 15531. | 2459. |
| 1986 | 938. | 936. | 1330. | 1083. | 1609. | 16049. | 2567. |
| 1987 | 976. | 973. | 1382. | 1126. | 1672. | 16553. | 2676. |
| 1988 | 1016. | 1009. | 1434. | 1168. | 1734. | 17041. | 2783. |
| 1989 | 1055. | 1045. | 1486. | 1210. | 1796. | 17513. | 2890. |
| 1990 | 1095. | 1081. | 1538. | 1252. | 1858. | 17968. | 2995. |

Table I-22

(Page 71 of 72)
Projection 12-B

P R O J E C T E D   R E Q U I R E D   M A N P O W E R   I N F L O W S

TOTAL OF GOOD'S PRODUCING AND OTHER SECTOR(MANUFACTURING PROJECTED AS ONE IND.)

OUTPUT ESTIMATE: HIGH(ESTIMATE 3)
OCCUPATIONAL COEFFICIENTS 1961-71,PROJECTED--THEN ASSUMED CONSTANT AT '71 LEVEL
ASSUMING: YEAR TO YEAR REQUIREMENTS MET: ZERO PERCENT
---------

| YEAR | ACTURARIES AND STAT. | ECONOMISTS | COMPUTER PROGRAMMERS | SOCIAL WELFARE WORKERS | PROF. OCCUPATIONS (N.E.S.) | TOTAL PROF.AND TECH. | TOTAL LABOUR FORCE |
|---|---|---|---|---|---|---|---|
| 1961 | -0. | -0. | -0. | -0. | -0. | 0. | 0. |
| 1962 | 109. | 66. | 25. | 374. | 1017. | 22403. | 143966. |
| 1963 | 248. | 159. | 58. | 742. | 2273. | 42170. | 284404. |
| 1964 | 406. | 261. | 96. | 1112. | 3651. | 63088. | 434400. |
| 1965 | 575. | 368. | 136. | 1484. | 5011. | 84593. | 621051. |
| 1966 | 726. | 464. | 171. | 1860. | 6587. | 105302. | 823134. |
| 1967 | 837. | 537. | 195. | 2236. | 7579. | 122999. | 913872. |
| 1968 | 987. | 632. | 228. | 2614. | 8907. | 142816. | 1049076. |
| 1969 | 1143. | 729. | 262. | 2996. | 10281. | 162840. | 1187550. |
| 1970 | 1305. | 831. | 298. | 3379. | 11706. | 183074. | 1327827. |
| 1971 | 1475. | 934. | 334. | 3764. | 13181. | 203520. | 1462590. |
| 1972 | 1625. | 1042. | 372. | 4151. | 14511. | 223731. | 1633070. |
| 1973 | 1779. | 1152. | 411. | 4538. | 15877. | 244118. | 1807684. |
| 1974 | 1939. | 1266. | 451. | 4925. | 17281. | 264685. | 1984924. |
| 1975 | 2103. | 1383. | 494. | 5315. | 18723. | 285432. | 2165886. |
| 1976 | 2271. | 1504. | 537. | 5704. | 20202. | 306363. | 2349601. |
| 1977 | 2446. | 1628. | 582. | 6092. | 21719. | 327479. | 2536632. |
| 1978 | 2625. | 1755. | 629. | 6481. | 23274. | 348783. | 2726921. |
| 1979 | 2808. | 1886. | 677. | 6869. | 24866. | 370276. | 2920511. |
| 1980 | 2997. | 2019. | 728. | 7257. | 26498. | 391958. | 3117404. |
| 1981 | 3175. | 2142. | 776. | 7579. | 28052. | 412895. | 3317000. |
| 1982 | 3358. | 2267. | 826. | 7899. | 29639. | 433979. | 3520070. |
| 1983 | 3544. | 2394. | 878. | 8214. | 31260. | 455209. | 3726724. |
| 1984 | 3735. | 2524. | 931. | 8525. | 32915. | 476582. | 3936912. |
| 1985 | 3931. | 2656. | 986. | 8832. | 34603. | 498095. | 4150744. |
| 1986 | 4130. | 2791. | 1041. | 9135. | 36325. | 519746. | 4368361. |
| 1987 | 4334. | 2928. | 1099. | 9433. | 38082. | 541528. | 4589647. |
| 1988 | 4542. | 3067. | 1158. | 9726. | 39875. | 563441. | 4814616. |
| 1989 | 4753. | 3208. | 1219. | 10015. | 41703. | 585477. | 5043387. |
| 1990 | 4970. | 3352. | 1280. | 10298. | 43569. | 607636. | 5275991. |

Table I-22

force between 1961 and year t-1 as well as for the 1961 base year stock.[12] It was assumed that new entrants were in the 20-24 age group when they entered the labour force. The estimates of the required manpower inflows made under this assumption are designated in Table I-22 as "Year to Year Requirements Met: 100 per cent."

In both sets, attrition was computed using the "Provincial and Regional Life Table, 1960-61" (DBS Cat. No. 84-517, 1964). The method used by Meltz and Penz (1968) was followed. The limitations of this method have been discussed in Part A, Chapter V. Several important assumptions should be noted:

(1) Due to non-existence of data on death and retirement by occupation it is assumed that attrition due to death and retirement is related only to the age-sex structure of each occupation.

(2) Net movement between occupations is assumed to be zero.

(3) Because data is lacking, neither emigration nor interprovincial migration are included in attrition.[13]

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[12] For example, for mechanical and industrial engineers the attrition during 1961-90 of those who enter the labour force over this period is about 9.37 per cent of the attrition of the 1961 stock over the same period.

[13] One could introduce a projection of net immigration by occupation. Since net immigration to Ontario has generally been positive for most high level occupations, this adjustment would probably reduce the required inflow projections. On the other hand, one could use unadjusted projections of required inflows to spot the occupations where immigration constituted a serious threat to Canadian job seekers. This model would allow a closer integration of immigration policy with manpower policy than presently exists in Canada.

1. Sensitivity of projections

In terms of the sensitivity of the required manpower inflows with respect to the changing values of the component parts of the manpower projections model, the following conclusions can be drawn:

a. level of aggregation: manufacturing considered as one industry vs. manufacturing divided into subsectors: The variation in the required manpower inflows for the total labour force between the two levels of aggregation is about 0.2% of the projection. The projection based on manufacturing considered as one industry is the higher of the two. For projections of specific occupations, the pattern is not consistent. In some cases, civil engineers, chemical engineers and chemists, the projected required manpower inflows are higher when manufacturing is considered as one industry. In other cases, mechanical plus industrial engineers and electrical engineers, the projected required manpower inflows are lower when manufacturing is considered as one industry. In still other cases, the projected required manpower inflows are nearly the same, e.g. architects, veterinarians, social welfare workers.

b. output projections: Three projections of output were made for the manufacturing sector. The overall growth rates were projected to be 3.5%, 4.0% and 4.5%. In terms of the required manpower inflows, each 1/2% increase in annual

growth of output was associated with an increase of roughly 250,000 persons (about 10%) in the labour force projection for 1990.

2. Comparison with Ahamad and Watson-Butorac projections

There have been two recent studies giving manpower projections for Ontario, those of Watson and Butorac (1968) and of Ahamad (1970). Each of these studies employed a somewhat different methodology and used different definitions from those reported here. Because of these differences, straightforward comparison of these studies can be misleading.[14] Nevertheless, a cautious comparison of projections among different studies may be interesting. Such a comparison for the Year 1975 is presented for selected occupational groups in Table I-24. The assumptions underlying the selected figures in the comparison are shown in the table. It should be noted that the required inflow projections compared are those calculated as the differences between the gross manpower requirements in 1975 and the number of members of the 1961 stock still in the labour force in 1975. This corresponds to the first of the two assumptions about attrition

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[14] A somewhat detailed discussion of the difficulties of making comparisons among these and other projection studies is given in Skolnik and McMullen (1970: 3-7).

TABLE I-24

Required Manpower Inflows 1961-1975 for Selected Occupations:
A Comparison with Ahamad (1970) and Watson-Butorac (1968) Projections[a]

| Occupation | Occupational Co-efficients Assumed Constant at 1961 Values | | | | | |
|---|---|---|---|---|---|---|
| | Based on Manufacturing Output Projections by Sub-sector | | | Based on Aggregated Output Projections for Manufacturing Sector | | |
| | Low | Medium | High | Low | Medium | High |
| Mechanical and Industrial Engineers | 8,335 | 8,743 | 9,172 | 7,510 | 7,861 | 8,225 |
| Electrical Engineers | 5,400 | 5,574 | 5,754 | 5,024 | 5,172 | 5.325 |
| Chemical Engineers | 1,626 | 1,723 | 1.822 | 1,787 | 1,881 | 1,978 |
| Actuaries and Statisticians | 1,847 | 1,902 | 1,959 | 1,712 | 1,757 | 1,804 |
| Professional and Technical (total) | 276,187 | 279,325 | 282,580 | 274,150 | 277,151 | 280,255 |
| Total Labour Force | 2,416,542 | 2,466,734 | 2,519,129 | 2,417,057 | 2,466,776 | 2,518,197 |

[a]This comparison is based on the "Year-to-Year Requirements Met: Zero" assumption. Under this assumption, the required inflows are calculated as the gross manpower requirements for 1975 less the number of the 1961 stock who survive in the labour force to 1975. Further discussion of this assumption is given in the text, pp. 67-68.

TABLE I-24 (Continued)

| Occupation | Projected Occupational Co-efficients | | | | | |
|---|---|---|---|---|---|---|
| | Based on Manufacturing Output Projections by Sub-sector | | | Based on Aggregated Output Projections for Manufacturing Sector | | |
| | Low | Medium | High | Low | Medium | High |
| Mechanical and Industrial Engineers | 7,625 | 8,025 | 8,446 | 6,882 | 7,213 | 7,556 |
| Electrical Engineers | 5,285 | 5,461 | 5,643 | 4,946 | 5,096 | 5,251 |
| Chemical Engineers | 2,407 | 1,495 | 1,583 | 1,837 | 1,933 | 2,032 |
| Actuaries and Statisticians | 2,417 | 2,214 | 2,285 | 1,988 | 2,045 | 2,103 |
| Professional and Technical (total) | 277,701 | 281,065 | 284,564 | 278,824 | 282,073 | 285,432 |
| Total Labour Force | 2,079,873 | 2,120,875 | 2,163,885 | 2,083,081 | 2,123,787 | 2,165,886 |

TABLE I-24 (Continued)

| Occupation | Lowest of Alternative Estimates | Highest of Alternative Estimates | Ahamad (000s) | | Watson-Butorac[c] | | |
|---|---|---|---|---|---|---|---|
| | | | Low | High | Gross Manpower Requirements | Survivor of 1961 Stock in 1976[d] | Required Manpower Inflows (Estimate) |
| Mechanical and Industrial Engineers | 6,882 | 9,172 | 9.0 | 9.5 | 6,590 | 4,742 | 1,848 |
| Electrical Engineers | 4,946 | 5,754 | 4.6 | 4.8 | 5,870 | 3,053 | 2,817 |
| Chemical Engineers | 1,407 | 2,032 | 1.6 | 1.7 | 2,005 | 1,295 | 710 |
| Actuaries and Statisticians | 1,712 | 2,285 | 3.6[b] | 3.7[b] | 5,150 | 1,179 | 3,971 |
| Professional and Technical (total) | 274,150 | 285,432 | 329.5 | 334.6 | 375,881 | 177,533 | 198,348 |
| Total Labour Force | 2,079,873 | 2,519,129 | 1674.8 | 1703.6 | 2,935,400 | 1,632,883 | 1,302,517 |

[b] Actuaries only

[c] Projection for 1976

[d] Our estimate

discussed above, and designated in Table I-22 as "Year to Year Requirements Met: Zero." This assumption was selected because it would provide for a more meaningful comparison than would the other assumption. Ahamad did not calculate attrition of those persons entering the labour force during the projected period. Watson and Butorac did not estimate attrition at all in their Volume I. Estimates of attrition of the 1961 stock used in this study have been applied to the projection of gross manpower requirements of Watson and Butorac in order to obtain the required manpower inflows which appear in the last column of Table I-24.

As shown in the table, Ahamad's projected required manpower inflows in the period 1961-75 for mechanical and industrial engineers plus chemical engineers fall between our lowest and highest estimates. The projected required manpower inflows for electrical engineers are higher than Ahamad's. The Watson-Butorac projections are much lower than both Ahamad's and our projections. In the case of actuaries and statisticians, our projections are much lower than either the Ahamad or Watson-Butorac figures. Our estimate for total professional and technical occupations lies between the Watson-Butorac and Ahamad projection. Our projected required manpower inflow for the total labour force is higher than either Watson-Butorac or Ahamad. This difference is mainly due to the assumptions

about changes in productivity. In projecting the occupational co-efficients we assumed a slowing down of the rate of increase in productivity, as explained in detail earlier. The other projections have assumed a continuation of the linear trend of the 1951-61 period.

## CHAPTER II

## PROJECTION OF POST-SECONDARY ENROLMENT

### A. Objectives and Coverage

#### 1. Objectives

The objectives of this section are to:

i) analyze historical data on enrolment in post-secondary education in Ontario, with emphasis upon flows of students through the system and flows from secondary school to the post-secondary level; ii) discuss briefly the choice of methodology for making enrolment projections; iii) project enrolment for the principal parts of the post-secondary system to 1990.

The methodology used in making projections will be discussed in Section B below. In that section, we will describe the general features of projection models, but we will not go into extensive details on the plethora of variants of the basic approaches. Historical data on enrolments will be analyzed in Section C. In Section D, we will discuss the methodology which we have adopted for making enrolment projections and present the results of our projections. Alternative projections will be presented. These alternatives reflect different data sources and different methods of projecting trends. The main differences arise from the choice of a data base. The data from the Ontario Department of University Affairs (hereafter "University Affairs") cover only provincially assisted universities and are based on different definitions

than are the DBS data on university enrolment for Ontario. This point is important and will be repeated several times throughout the chapter. Conclusions to be drawn from the projections will be discussed in Section E.

2. Coverage

The post-secondary educational system in Ontario is diverse. It includes universities, teachers' colleges, schools of nursing, Ryerson Polytechnical Institute, registered private schools, colleges of agricultural technology, the Ontario College of Art, and the Colleges of Applied Arts and Technology.

Our primary concern is with the universities, which comprised about 54 per cent of the total post-secondary enrolment in 1968-69. We have projected enrolment also for the Colleges of Applied Arts and Technology, comprising 14 per cent of post-secondary enrolment in 1968-69. In the case of teacher training institutions, which accounted for 6 per cent of post-secondary enrolment in 1968-69, future demand for graduates (but not enrolments) has been projected. Thus, we have covered about three-quarters of the post-secondary educational sector. The remaining institutions are mainly schools of nursing, registered private schools, or special institutions, such as Ryerson and the agricultural colleges. The data for registered private schools and schools of nursing simply were not adequate for analysis or projection. The structure of nursing education is complex and would require a special study just to assemble a good annual series of enrolment by type of program.

A "back of an envelope" projection of nursing enrolment would not have been consistent with the detailed analysis undertaken of the other sub-sectors for which we have made projections. Projections of enrolment for a single institution should take into account the unique peculiarities and plans of the institution. In the case of Ryerson, the recent attainment of degree granting status may so change the nature of enrolment demand that extrapolation of past trends will be misleading. Moreover, projections for any single institution are very sensitive to even minor changes in its nature or its environment. Such projections are better left to special studies which look at that institution as a particular phenomenon.

## B. A Survey of Methods and Recent Studies

### 1. Methods

Starting from the fundamental assumption that there will be no radical redevelopments of the structure of the educational system and educational policy or of institutional behaviour, there are two basic components to the task of projecting enrolments:

(1) analyzing historical data, and

(2) producing extrapolations of perceived trends in those data.

In Canada, as in most nations, there exist only unidimensional (stock) data on the historical phenomenon that is enrolments.

Stock data pertains to the position (location and/or status) of a group of students at one point in time. It provides no information on the position of that group (i.e. its members) at earlier points in time. As a consequence of the limitation imposed by reliance upon stock data, nearly all existing post-secondary enrolment projection studies have resorted to one of two basic approaches.

In the first, the participation rate method, stock data on enrolments are related to population in an age group (usually 18-21 or 18-24). In the second, the stock data are disaggregated into years of program (e.g., first year university, second year, etc.). Flows through the system are estimated by comparing the stock of second year (third, etc.) students in year t to the stock of first year (second, etc.) in year t-1. The perceived trends in historical data are then extrapolated. By drawing an extension of a visible "line" in the data, or by fitting a linear or higher order regression equation to the data, the "future" is portrayed. Sometimes the extrapolations are more verbal than geometric or algebraic, allowing the person doing the projections to make "liberal" interpretations of the future of current trends.

It is sometimes claimed that there is a large number of methods of making enrolment projections, e.g. Lins (1960) lists six or seven "methods". All of these methods involve projecting either the stock of enrolment or the flow between successive

points in the system. All rely on stock data, although, as will be discussed below, there is some possibility of genuine flow data becoming available in the future. In those methods which project the stock of enrolment, the stock is either extrapolated directly, or, as is more common, the ratio of enrolment to population is projected. In the latter approach the enrolment ratio is usually projected as a simple function of time, graphically or through regression equations of varying degrees of complexity. Alternatively, the regression equation could include some socio-economic (income, family size, etc.) or cost (e.g. fees) variables as well. In most cases, however, adding these socio-economic variables to the regression equation has not noticeably increased the predictive power of the equation, and these variables are often more difficult to predict than enrolment itself.

There are many variations to what we have called "flow models based on stock data." The basic exercise, however, is one of analyzing the ratio of enrolment at (one) level(s) of education in a given year to enrolment at (a) lower level(s) in (an) earlier year(s). For example, one might relate enrolment in first year university to the weighted average of secondary school enrolment one, two, and three years earlier. The range of possible ratios is enormous. These ratios also may be projected solely as a function of time or time plus selected socio-economic variables. Enrolment projections generally have

involved the application of simple models to the analysis of collective personal and institutional decisions. The main problems, as we will show below, have been the paucity and poor quality of data. With inadequate data, there seems little point in developing ever more sophisticated models. Moreover, it does not seem worthwhile to go into detail about the great number of potential variants of the basic methods of enrolment projection.

In Ontario and Canada, universities and provincial departments of education have been preparing forecasts of enrolments for a long time. Generally, these have been estimates for the "short run" (typically up to five years) and for the advice of administrators rather than for publication. Our interest here is with the more scarce published (or at least available for general circulation) projections of medium or long range (i.e., more than five years and more than ten years, respectively). Not only are they scarce, but their history in Ontario is a short one.

The first important example is the report of the Plateau Committee. It was established in 1954-55 by the Senate of the University of Toronto; its chairman was Professor G. de B. Robinson. It estimated enrolment for that university, by year, to 1968-69. It also estimated the enrolment futures of Ontario students at Toronto, Queen's, McMaster, and Western Ontario and

at McGill University in Montreal. The tables of projections were prepared by Professor B. A. Griffith of the Mathematics Department. Applying the participation rate method, and using regression analysis, he offered five projections based on different assumptions about the participation rates of the university age group (18-21). In the case of the University of Toronto, his "best" projection (i.e., closest to future actual statistics) was based upon the assumption of a linearly increasing percentage of the 18-21 age group attending that university.

The economic and political significance of enrolment projections was widened in the early 1960s when the comprehensive enrolment projections of Professor R. W. B. Jackson (1962) appeared. These were the first extensive and sustained efforts at projecting enrolments in Ontario for all years of university through graduate programs. In 1962, Dr. Jackson's estimates of the number of Ontario youths who would be wanting to attend universities for each year up to 1970 were published. They included tabulated data on Ontario's population plus enrolments in elementary and secondary schools and in universities at the undergraduate level. Jackson prepared six estimates of undergraduate enrolments based on projected Grade 13 enrolment and projected numbers in the 18-21 age group.

These projections were used frequently by university planners in the 1960s. It is appropriate to note that not only did

he use both the 18-21 age group and Grade 13 enrolments as bases for his enrolment projections, but in the latter case he resorted to multiple year Grade 13 enrolments averages in order to make the transition ratios more sensitive to delayed entry into the universities.

In The Problem of Numbers (1963), Jackson used enrolment projections to focus popular and official attention upon the problems of accommodating future cohorts of university students in Canada. While he emphasized the problems in doing enrolment projections, it must be conceded that this piece of writing motivated the increased interest in projections in the late 1960s.

Professor E. F. Sheffield's estimates in Enrollment to 1976-77 in Canadian Universities and Colleges (1964, 1966 revised) are based on the population participation rates method. He used the participation rate for the 18-24 age group for each sex in Canada. Because of his emphasis upon increasing female attendance, his separate projections for each sex are significant.

Two quite recent post-secondary enrolment studies are of particular interest as examples of a perennial problem in projection work: significant differences in numerical results due to different underlying assumptions and definitions.

In the first of these, Watson and Quazi (1968) projected Ontario university and college enrolments to 1981-82 using both the population participation rate method and the Grade 13--

first year university transition method.

In the second, Zsigmond and Wenaas (1970) projected enrolments for Canada to 1980-81 by province. Using the population participation rate method only, they got quite different results for Ontario from those of Watson and Quazi. The difference between the studies is due in part to the definition of undergraduate and graduate students at universities. As an example, Watson and Quazi define a university undergraduate as a student in a program (excluding preliminary year operations) requiring Grade 13. Zsigmond and Wenaas include within their definition of undergraduate certain preliminary and diploma students who are not covered by Watson and Quazi's definition. Regarding the definition of graduate students, Watson and Quazi classify as graduate students all those in programs requiring a first degree. Zsigmond and Wenaas, however, classify as undergraduate some students in programs requiring a Bachelor's degree but leading to a first professional degree.

These definitional differences between the two studies reflect differences in the data used as much or more than differences in the viewpoints of the people involved. However, a more important difference is their assumption about the increasing rates of university participation in the 18-24 age group. Zsigmond and Wenaas assume the more rapidly rising rate. An interesting but very brief discussion of these two projection sets is found in Toward 2000 (Porter, Blishen, et al, 1971,

pp. 47-52). This report prepared for the Committee of Presidents of Universities of Ontario compares two sets of the Watson and Quazi projections with the highest set of the Zsigmond and Wenaas projections. The report expresses a preference for the latter, it being based on an assumed participation rate higher than that for either set from the former. In the Watson and Quazi study, those enrolment projections based on the higher of their two participation rate assumptions give enrolments higher than those of Zsigmond and Wenaas for the years 1968-69 through 1971-72 and lower for the years 1972-73 through 1980-81. This configuration is due to the combination of different definitions and assumed participation rates. For the years 1968-69 through 1970-71, the Watson and Quazi figures are closer to the actual than are the newer Zsigmond and Wenaas results. The projections reported in this chapter, based on later data (an extra three years over Watson and Quazi and an extra two years over Zsigmond and Wenaas) produced results (2C, based on DBS data) only a little higher than those of Watson and Quazi, but considerably lower than those of Zsigmond and Wenaas (by 33,000 in 1980).

These projection studies may be described as "competing" sets of predictions. As such their differences and the unfurling actuals are of some amusement to the people who produced them. The important thing about these differences, however, is that they point to the unfortunate reality that the information

gained from separate projection studies is rarely "additive"; indeed, we may even doubt that their value is "cumulative".

With the advent of computers with their vast capacity to store and process information, a new era in the development of information systems emerged. One result of this has been increased interest in flow models based on flow data. The requirement for such models is year-to-year information on individual students in the educational system. Because each student is identified individually, it is possible to observe the flow of students through the entire education system. It is this facility of observing the flow of students through the system which gives the model its name and its perceived potential as a flexible tool of policy studies.

The main advantage of these models is their capacity for analyzing the performance of the system and allowing for simulation of the effects of contemplated changes in educational policy. Flow models were not developed for the purpose of making enrolment projections but to provide an analytical tool for managing education systems.

Though there has been some interest in using flow models for enrolment projections, there is yet no reason to believe that flow models will enable more accurate projections of enrolment than the other projection methods. Given the accuracy of previous projections with other methods, there would be little justification for the great expenditures required for the

development of information systems needed for flow models. If, however, these information systems are developed for other reasons, principally for purposes of systems management, it will be worthwile to attempt to make enrolment projections from flow data.

It would be instructive, of course, to compare any such projections with the projections obtained from presently used methods. However, the data required for the use of "pure flow models" in enrolment projection are not available, and are not likely to be available very soon. Since projections with the participation rate method or with yearly flows estimated from stock data have been reasonably accurate, this is certainly not the most unfortunate aspect of conditions faced by those who would improve the techniques of enrolment projection.

2. Annotated references on enrolment projections

Banks, J., and Hohenstein, G. L., Conceptual Models and Procedures for Predicting Higher Education Enrollment. Paper presented at the 38th National O.R.S.A. Meeting, October 28-30, 1970.

Projections are made for the period 1970-80 using three methods which the authors have developed. The first of these is a historical enrolment model (trend model) using data from the State of Georgia. The model is based on the assumption of a continuation of the previous general pattern of state and national policy on higher education. The second method is the development of a simple linear regression model. The third model is a linear multiple regression model providing projections for the period 1970-80.

Borrie, W. D., and Dedman, Ruth M., University Enrolments in Australia, 1955-70. Canberra, Australian National University.

The projections outlined in this publication for the period 1955-70 used the participation ratio technique. Five projections were done under different assumptions. These assumptions were as follows: Assumption A--no immigration after June 1955; Assumption B--net immigration of all ages of 100,000 a year; Assumption I--enrolments remaining at the level of 433 students per 10,000 population aged 17-22; Assumption II--enrolments rising from 433 in 1955 to 500 in 1970; Assumption III--enrolments continuing to rise at the same rate as 1951-55.

California Department of Finance, Projections of Enrolment for California's Institutions of Higher Education, 1960-75. Sacramento, California Department of Finance, 1960.

This study was done in conjunction with the Master Plan Survey for California's institutions of higher education. Projections for the period 1960-75 were based on the assumption that the pre-1960 enrolment trends would continue, and thus were extrapolations. These projections were then used to formulate policy to guide and modify these expected future enrolments.

Cowan, R. W. T., Education for Australians. Melbourne, F. W. Cheshire, 1964.

Projections for higher education in this publication were calculated by the enrolment ratio technique. The assumption was made that enrolment rates would rise between 1961 and 1966 and then remain constant at the 1966 level. Actual student enrolments from 1951-62 were used as a base and then projections were made for the period 1963-75.

Davis, Russell G., Planning Human Resource Development, Educational Models and Schemata. Chicago, Rand McNally Company, 1966.

Davis, in his book, does not make any actual projections of enrolments in higher education, but must be mentioned for the fact that he does provide an excellent outline of methods available for projection. He presents in his text under the headings of models such methods commonly known as enrolment ratio, grade-survival ratios, and least-square analysis.

Greenawalt, George J., Predicting School Enrollments. Cambridge, Mass., New England School Development Council, 1966.

Although Greenawalt does not make any projections in this book he offers a good evaluation of the "percentage of

survival" technique of projecting educational population.

Illing, Wolfgang M., and Zsigmond, Zoltan E., Enrolment in Schools and Universities, 1951-52 to 1975-76. Ottawa, Queen's Printer, 1967.

This publication offers projections for the period 1966-67 to 1975-76 for teachers' colleges, technical institutions, and universities. All projections are made using the enrolment ratio technique. The ratios used represent enrolments as percentages of the 18-24 age group.

Illinois Higher Education Commission, Illinois Looks to the Future in Higher Education. Report of the Commission to the Governor and Legislature of the State of Illinois, 1957.

In order that college enrolment projections could be made, the college-age population for 1954-77 was projected using the cohort survival method. The 1949-51 State of Illinois Life Tables were used for this purpose. The actual enrolment projections were made using the enrolment ratio method. Using the United States Office of Education data for the period 1905-50, the average annual increment in the enrolment rate was calculated as .32 per cent. Due to the fact that enrolments in 1954 were known to be especially high, adjustment was made to the rates for 1957-64. The rates for 1965-67 were based on the trend line arrived at using the method of least squares and data from 1905-45. For the period 1968-77 a downward trend was assumed, thus the average annual increment of .32 percent in the enrolment rate was reduced by 5 per cent per annum.

Klassen, Peter P., College-age Population Projections and Enrollment Estimates in Illinois to 1977. Report to the State of Illinois Higher Education Commission. Chicago, University of Illinois, 1956.

Klassen projected the college-age population 18-24 years for the years 1955-77 by extrapolation of past trends. He assumed in Series A no net migration and in Series B, migration like the 1930-50 period. He also made the assumption that both birth and death rates will remain constant.

Leybourne, Grace G., and White, Kenneth, Education and the Birth Rate: A Social Dilemma. London, Jonathan Cape, 1940.

Although Leybourne and White's book tended to be a non-mathematical report of the effect of changing birth rates

on education, they did offer a brief projection of total numbers of university students in England and Wales from 1938-65. This projection involved the use of the enrolment ratio technique and provided estimates under two contingencies, A and B, which allowed for different birth rates.

Lins, L J., *Methodology of Enrollment Projections for Colleges and Universities*. Washington, American Association of Collegiate Registrars and Admissions Officers, 1960.

Lins outlines four methods of projection: (i) curve-fitting, (ii) enrolment ratio, (iii) cohort-survival, and (iv) correlation analysis. Following this outline of methods, he demonstrated how these methods may be applied to both short-range and long-range projections of enrolments. He concluded with a chapter on methods of presenting the data.

Liu, Bangnee Alfred, *Estimating Future School Enrolment in Developing Countries: A Manual of Methodology*. New York, UNESCO, 1966.

Liu's book presents two basic methods of enrolment projections which may be used to project enrolments in institutions of higher education. He outlines step-by-step procedures for the use of the "enrolment-ratio method".

Presidents Research Committee, *From the Sixties to the Seventies: An Appraisal of Higher Education in Ontario*. University of Toronto Press, 1967.

This publication was prepared in order to provide direction for university policy and expansion in Ontario in the 1970s. The projections of full-time enrolments in Ontario universities that were used for the purposes of the report were done by The Ontario Institute for Studies in Education. The projections were made for the years 1966-81 and were based on data for the period 1962-66.

Organization for Economic Co-Operation and Development, *Methods and Statistical Needs for Educational Planning*. Paris, OECD, 1967.

The text outlines both data necessary and methods of collection of data for enrolment projections. Chapter VIII and Tables 9 and A provide excellent examples of some of the suggestions relevant to enrolment projections of higher education.

Report of the Committee Appointed by the Prime Minister under the Chairmanship of Lord Robbins, 1961-63, Higher Education, Appendix One, "The Demand for Places in Higher Education." London, Her Majesty's Stationery Office, 1963.

The higher education enrolment projections for 1962-80 in this report were calculated from data for 1958-61 by using the number of projected secondary school graduates and allowing for a 10 per cent increase of the 1958-61 trends in the percentages of each group of secondary school graduates who will attend higher education institutions over the period 1962-80. Separate projections were done for England, Wales and Scotland for all types of higher education, including such institutions as teacher training colleges, universities, and colleges of advanced technology.

Report of the Presidents of the Universities of Ontario to the Advisory Committee of Presidents of Provincially Assisted Universities, Post-Secondary Education in Ontario, 1962-1970. Ontario, May 1962 (revised January 1963).

Two estimates of projected enrolments of full-time undergraduate students were presented for the report for the period 1963-72 by R. W. B. Jackson. Both projections used an enrolment ratio technique in that the projections were based on assumed ratios of university students to Grade 13 students. The first projection assumed that the percentage of 4-year cumulative Grade 13 (September) enrolment in university would remain at a constant level of 50 per cent. The second projection was based on the assumption that although enrolment had decreased in the period 1961-64, there would be an increase from 1964-72 at which point they would be approximately 60 per cent of the 4-year cumulative Grade 13 (September) enrolments.

In June 1963, a supplement was published for this report in which two revised projections were made by Jackson in light of the increased number of drop-outs from the top grades in the secondary school at that time. Using the same methodology as was used in the 1962 study, one projection was done under the assumption that the increase in drop-outs would continue to 1971, while the other was done under the assumption that the drop-out phenomenon would be only temporary and the long-range trend would re-assert itself.

Report by the Population Study Group, Higher Education Study, Michigan Council of State College Presidents, Future School and College Enrollments in Michigan, 1955-1970. J. W. Edwards, 1954.

This publication attempts to make five different projections of college population for 1955-70, all using the enrolment ratio technique. The five projections allow for different assumptions of the actual student ratios expected in the future.

Report and Recommendations of the Committee for Development of Tertiary Education in Victoria, The Development of Tertiary Education in Victoria, 1963-72. Victoria, 1963.

Using data for the years 1954-60, projections were made of university enrolments in Victoria for the period 1962-71. The method employed in these forecasts may be called the "Progression Ratio Method", and is characterized by the following stages:

(a) Enrolments at each of the grade or form levels of the primary and secondary school for a succession of years are used to determine trends in the proportion progressing from one level to the next.

(b) By applying these trends to current enrolments, estimates of future enrolments at particular grade and form levels are determined. In this case estimates of future Form 6 enrolments are the key estimates.

(c) Enrolments at Form 6 level, numbers of entries and passes at the matriculation examination, and number of university new entrants for a succession of years are used to determine trends in the proportion of students progressing from Form 6 to the university.

(d) By applying the trend of (c) to the estimates of future Form 6 enrolments (b above) estimates of future university new entrants are determined.

(e) Total university enrolments and university new entrants for a succession of years are used to determine the trend in the proportion of the total university enrolment that pass out of the university.

(f) Current total university enrolment, estimates of future university new entrants, and estimates of future exits (e above) are used to determine estimates of future total university enrolments.

Ruiter, R., The Past and Future Inflow of Students into the Upper Levels of Education in the Netherlands. Netherlands, 1963.

Although Ruiter makes no actual projections, he offers two suggestions for integral forecasting models. "The first models were based on trend extrapolation of inflow into universities as a percentage of 18 years old or on total enrolment in universities as a percentage of 18-25 years old. Another model was based on the relationship between university enrollment as a percentage of 18-25 years old on per capita income."

Russell, John Dale, Higher Education in Michigan: The Final Report of the Survey of Higher Education in Michigan. Lansing, Michigan Legislative Study Committee on Higher Education, 1958.

For the purpose of this survey forecasts of the future college enrolments were "based on the number of college-age people who will be living in the future years (to 1975), estimated from the known number of births, with corrections for mortality up to the normal ages of college attendance. One forecast assumed no increase in the percentage that enrolments will be of college-age population, beyond the percentage in 1956; a less conservative forecast assumed that the percentage, which was 39.4 in 1956, would increase at the modest rate of 0.5 per cent a year up to 1970."

Schmid, Calvin F., and Miller, Vincent A., Population Trends and Educational Change in the State of Washington. Seattle, Washington State Census Board, 1960.

Using the enrolment ratio technique, Schmid and Miller demonstrate the trend in the number of college students in the State of Washington from 1910 to 1950. They also estimate the increase in the enrolment ratio that might be expected by 1970 and the number of students that would result from this increase.

Statement by Hon. P. O. S. Skoglund, New Zealand School Population. Wellington, New Zealand, R. E. Owen, Government Printer, 1959.

Projection of university enrolment was made using the grade survival method and a series of various assumptions for the period 1959-72. The first assumption combines in one figure what are really two ratios, (a) the number of Form VI pupils passing university entrance, and (b) the number of first year students as a proportion of entrance

passes. It was assumed that this ratio would decline to 0.41 by 1962. After 1962 the alternative assumptions were made that the ratio would remain at 0.41 or further decline to 0.40 by 1972. The second assumption, on progress at university, used four alternative patterns. They assumed that the average length of the university course would range from three years, nine months, to four years, one month.

Thompson, Ronald B., Estimating College-age Population Trends 1940-1970. Columbus, American Association of Collegiate Registrars and Admissions Officers, 1954.

In order to project the college-age population for the United States as a whole and for the individual states, Thompson relied on State and Regional Life Tables, 1939-41, published by the National Office of Vital Statistics, for his base data. From this data, he uses the cohort survival method to estimate the college-age population to 1970 for each state of the U.S.

Thomsen, Ole B., Problems in Educational Planning: Educational Planning Seminar, 1966. Toronto, The Ontario Institute for Studies in Education, 1966.

Although Thomsen does not make any projections of university enrolments, he does offer a brief evaluation of both the enrolment-ratio approach and grade-survival approach to projection of university enrolments. At the same time, he outlines briefly how Denmark has attempted to improve the use of the grade-survival technique.

U. S. Office of Education, Department of Health, Education and Welfare, Projections of Educational Statistics to 1977-78. Washington, U.S. Department of Health, Education and Welfare, 1968.

Using actual data for 1957-67 projections of total enrolments, and enrolments by sex, status and type of university attended were made for institutions of higher education for the period 1968-1977. The enrolment ratio technique was used with the assumption that enrolments in these institutions, expressed as a percentage of population aged 18-21 would follow the 1957-67 trend to 1971 in each enrolment category.

White, R. Clyde, These will go to College: A Study of Future Demand for Admission to College by Secondary School Grade in the Cleveland-Akron-Lorain Area. Cleveland, The Press

of Western Reserve University, 1952.

White projected the number of secondary school graduates who would enrol in college for the period 1950-69, by assuming that the percentage of 18-year-olds enroled in 1950 (20.7 per cent) would remain constant to 1969 and would constitute freshman enrolment. It would seem that the assumption that the 1950 rate of enrolment would hold constant would make the accuracy of this projection very questionable.

## C. Description and Analysis of Historical Statistics on University Enrolment

The above survey of methods for enrolment projection makes clear that all the conventional approaches to this activity are linked to the documented history of the system and institutions involved. Perhaps the most important component of that documentation is the accumulation of statistics that constitute a quantitative abstract of the behaviour of the particular system or institution over time.

Educational statistics, like all other forms of documentation, are very imperfect historical sources. They reflect the diligence of a series of high- and low-level officials in the task of quantifying and recording activities; perceptions (which vary across institutions and over time) of what are appropriate facts to record and the best format for recording them; and changing requirements of statistical reporting. It is no easy task to render them into useful bases for speculation upon the future.

The treatment given to available historical statistics, and the adequacy of those statistics, is determined by the kinds

of questions one is dealing with. In this section it is intended to exploit available historical statistics in order to deal with questions about what are the reasonable assumptions to resort to concerning i) the impact of admission policies (particularly academic requirements) on first-year enrolment, or on total enrolment; 2) trends in retention rates, and their impact on enrolment; and 3) the relationship between the outputs of the secondary school system and the demand for post-secondary education.

1. <u>Admission policies and first-year enrolment</u>

The intake of freshmen in a particular course at a given university depends upon the admission policy (policies) of that institution and the number of applicants. Admission policy, in turn, consists of three main components: i) structural constraints (i.e., institutions or levels from which student applications are considered); ii) capacity constraints (i.e., the number of students the institution is willing to accommodate with its current resources); and iii) academic standing constraints (i.e., the minimum competitive standing in school examination marks required for eligibility to admission).

Admission to a prestigious university is first determined by the capacity constraint. Academic standing constraints and perhaps structural constraints will then be invoked to ration places. Less prestigious institutions (or faculties within a

a prestigious institution) may have low academic requirements and a generous definition of appropriate preparatory institutions or levels. Moreover, they may frequently vary these requirements, officially or unofficially, to fill all their places. Universities, and other institutions, typically enjoy a great deal of autonomy in defining their own structural and academic standing constraints.

Nevertheless, in a system like that of the universities of Ontario the fact that all of the universities depend upon the same reservoir of potential students serves to integrate them. The results of their separate admission requirements and those requirements themselves are not independent of one another. Applicants choose among the institutions according to some preference order, and students rejected by one institution may be accepted by others. Little can be said about the complex process implicit in this. Current and historical data only tell us the number of students enrolled in a course (institution). The number of students enrolled in the institution of their first (second, third, etc.) choice is not known, nor is it known which students enrolled elsewhere would have been accepted into a particular course (institution).

Only a portion of applicants (generally the highest ranking Grade 13 graduates) are not affected by the structural or academic standing constraints. However, since there is no information on what student and institution options really were,

the impact of admission policies on first year enrolment behaviour can be only very imperfectly estimated. It is intended that in September, 1972 "all applications to all Ontario universities will pass through the clearing house, with the aim of fitting all applicants in more easily and efficiently matching courses and spaces in the province's institutions" (University Affairs, 1971: 28). The data acquired by such a clearing house may very well justify different assumptions about requirements and enrolment behaviour than now seem most plausible.

Certainly two of the fundamental assumptions incorporated in the methodology (Section D below) are that an increased supply of potential university students will be the result of increasing numbers of youths meeting formal admission standards, and that the rationing of scarce places will always be based primarily upon academic requirements.

In 1963, Dr. R. W. B. Jackson commented upon the rationing of university places at the beginning of the great expansion of the 1960s this way. "Suspicions have been voiced that the universities are planning to solve the 'numbers problem' by excluding more and more students, steadily closing the college door, so to speak, and taking advantage of the crisis to restrict admission to the select few gifted individuals who are highly motivated and practically self-teaching" (Jackson, 1963: 35).

In 1965 a report prepared by the City of Toronto Planning Board stated that due to raising of admission requirements by the University of Toronto, the percentage of persons in the 18-21 year age group attending that university had declined markedly since 1959. Of the prospective qualified applicants that year, 1,400 could not be admitted. Half of these appear to have been admitted to other universities of southern Ontario, and it is not certain what was the fate of the remainder. This condition appears to justify a claim that the University of Toronto no longer performs a role as a city university.

Whatever the consequences--and some of them may be defensible, even desirable--it is clear that the popularization of secondary education has resulted in raising formal (published) admission requirements.[1] This phenomenon is most obvious in the case of the well-established and prestigious universities. In their case it seems that *de facto* requirements are frequently even higher than the formal ones. In the case of less prestigious institutions it is probable that requirements frequently are lower than published statements indicate.

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[1]Table II-1 of this report presents an abstract of the history of admission requirements in Ontario universities. It contains forty pages of information relevant to the forecasting of enrolments. Since this historical information is only background to the enrolment projections presented in this chapter, that table is not included in this version of the report. It is available, with other material related to these projections, in the library of The Ontario Institute for Studies in Education and the archives of the Commission on Post-secondary Education in Ontario.

The situation in which the University of Toronto (and a few other of the more prestigious universities) is raising its standards due to capacity limitations while other universities are lowering theirs suggests a two-tiered rationing system. One in which formal requirements first determine how many Grade 13 graduates will go to university, and then determine which of those selected will go to the most prestigious institutions.

However, in a comparison of the admission requirements for five universities, it was noted that in some faculties where ratios of applicants to places are persistently high, no published changes in those requirements now appear.[2] This is strong evidence that published enrolment requirements are of little assistance in using Grade 13 class standings or examination results to estimate the universities to which graduates are eligible for admission. The projection methodology here assumes only that graduates meeting or surpassing formal requirements will be admissible to some university in the province.

A perusal of admission requirements over the period of 1918 to the present indicates that the general pattern was for Toronto to raise admission standards first, to be followed by the others.

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[2] See footnote 1.

In 1918 Toronto, Western, Queen's, and McMaster Universities had minimum admission requirements of 12 middle school papers for entry into first year of a pass B.A. course. A minimum of 40% on each paper was required with an average of 60% (the 60% average applied to Western only after 1919). Five upper school subjects were required for admission to first year honours or second year pass courses. A mark of 40% was necessary on each paper with 50% in certain papers for the honours courses.

In 1921 the University of Toronto raised admission requirements to 50% on each paper for admission to first year of an honours course. In 1922 Western and Queen's followed Toronto's lead. McMaster continued to give some special consideration to students with these qualifications.

In 1931 Toronto increased the number of senior matriculation subjects for entry into first year pass or honours courses, to be followed in time by the other universities. The Grade 13 exams were introduced in 1942. In irregular steps the four universities increased the requirements related to these examinations well into the 1950s.

In 1955 Toronto raised its admission requirements to 60% in 9 papers for admission to first year with the recommendation that higher marks be expected from honours applicants. Queen's and McMaster imposed similar requirements in 1956 and 1957 respectively.

At present, almost all universities in Ontario have the same minimum admission requirement of a 60% Grade 13 average with minor exceptions in some universities.

The important message in this history is that admission requirements are an important variable in controlling the rate at which the popularization of secondary education is reflected in university enrolments. No one is likely to venture a definitive statement of what a grade average of 60% or 70% in Grade 13 now means in relation to the same grade average 10, 20 or 50 years ago. But anyone intending to predict any relationships between the future stream of Grade 13 graduates and post-secondary enrolments must make certain assumptions about the future of admissions requirements.

2. Retention rates

Retention rates for provincially assisted universities have been computed for first to final years of full-time undergraduate enrolment by faculty for the years 1961 to 1970.

As the accompanying tables (II-2 through II-19) indicate, there is a remarkable variation in retention rates among institutions, and even among faculties in the same institution. In forestry, pharmacy, dentistry, and veterinary science, retention rates are notably stable (Tables II-5, II-6, II-8 and II-9). These faculties are also characterized by slow growth. Since pharmacy and veterinary science are each taught in only one institution, it is not surprising

TABLE II-2

Actual Full-Time Undergraduate Enrolment in Provincially Assisted Universities

And Retention Rates

in

General and Honours Arts

for the Province of Ontario

| Academic Year Beginning | First Year | Retention Rate | Second Year | Retention Rate | Third Year | Retention Rate | Fourth Year | Total |
|---|---|---|---|---|---|---|---|---|
| 1961 | 4227 | 90.9865 | 3273 | 96.9141 | 2632 | 23.2143 | 696 | 10,828 |
| 1962 | 4271 | 99.1805 | 3846 | 93.2137 | 3172 | 23.7074 | 611 | 11,900 |
| 1963 | 5305 | 89.4439 | 4236 | 91.1237 | 3585 | 23.4589 | 752 | 13,878 |
| 1964 | 6751 | 90.6384 | 4745 | 97.0074 | 3860 | 25.7513 | 841 | 16,197 |
| 1965 | 8504 | 81.9614 | 6119 | 88.1680 | 4603 | 20.5953 | 994 | 20,220 |
| 1966 | 9606 | 86.5813 | 6970 | 94.8924 | 5295 | 20.5931 | 948 | 22,919 |
| 1967 | 11,324 | 81.5789 | 8317 | 97.4390 | 6614 | 24.1004 | 1111 | 27,366 |
| 1968 | 12,832 | 101.1144 | 9238 | 108.2594 | 8104 | 26.5795 | 1594 | 31,768 |
| 1969 | 17,162 | 83.9471 | 12,975 | 88.0771 | 10,001 | 29.1971 | 2154 | 42,292 |
| 1970 | 17,916 | | 14,407 | | 11,428 | | 2920 | 46,671 |

TABLE II-3

Actual Full-Time Undergraduate Enrolment in Provincially Assisted Universities

and Retention Rates

in

General and Honours Science

for the Province of Ontario

| Academic Year Beginning | First Year | Retention Rate | Second Year | Retention Rate | Third Year | Retention Rate | Fourth Year | Total |
|---|---|---|---|---|---|---|---|---|
| 1961 | 1653 | 61.58 | 673 | 95.8395 | 550 | 60.9091 | 261 | 3137 |
| 1962 | 2075 | 55.66 | 1018 | 85.7564 | 645 | 50.5426 | 335 | 4073 |
| 1963 | 2313 | 57.03 | 1155 | 90.4762 | 873 | 48.2245 | 326 | 4667 |
| 1964 | 2677 | 65.11 | 1319 | 84.0030 | 1045 | 43.5407 | 421 | 5462 |
| 1965 | 3370 | 88.10 | 1743 | 102.0080 | 1108 | 54.2419 | 455 | 6676 |
| 1966 | 4528 | 82.29 | 2969 | 79.6901 | 1778 | 47.3566 | 601 | 9876 |
| 1967 | 4477 | 93.70 | 3726 | 80.4616 | 2366 | 49.9577 | 842 | 11,411 |
| 1968 | 5170 | 86.89 | 4195 | 70.2265 | 2998 | 43.4623 | 1182 | 13,545 |
| 1969 | 5004 | 104.64 | 4492 | 84.3722 | 2946 | 57.8072 | 1303 | 13,745 |
| 1970 | 6159 | | 5236 | | 3790 | | 1703 | 16,888 |

TABLE II-4

Actual Full-Time Undergraduate Enrolment in Provincially Assisted Universities

And Retention Rates

in

Engineering and Applied Science

for the Province of Ontario

| Academic Year Beginning | First Year | Retention Rate | Second Year | Retention Rate | Third Year | Retention Rate | Fourth Year | Total |
|---|---|---|---|---|---|---|---|---|
| 1961 | 1316 | 87.2340 | 947 | 77.7191 | 835 | 87.7844 | 863 | 3961 |
| 1962 | 1443 | 84.3382 | 1148 | 78.1359 | 736 | 92.6630 | 733 | 4060 |
| 1963 | 1717 | 82.2365 | 1217 | 81.7584 | 897 | 82.7202 | 682 | 4513 |
| 1964 | 1800 | 89.1111 | 1412 | 79.3201 | 995 | 85.5276 | 742 | 4949 |
| 1965 | 2098 | 87.4166 | 1604 | 79.1771 | 1120 | 82.2321 | 851 | 5673 |
| 1966 | 2484 | 87.1981 | 1834 | 82.0611 | 1270 | 77.9500 | 921 | 6509 |
| 1967 | 2677 | 84.7217 | 2166 | 89.7969 | 1559 | 77.7409 | 990 | 7392 |
| 1968 | 2765 | 82.4231 | 2268 | 80.4233 | 1945 | 79.4344 | 1170 | 8148 |
| 1969 | 2606 | 95.2417 | 2279 | 94.6468 | 1824 | 91.9956 | 1545 | 8254 |
| 1970 | 2619 | | 2482 | | 2157 | | 1678 | 8936 |

TABLE II-5

Actual Full-Time Undergraduate Enrolment in Provincially Assisted Universities

And Retention Rates

in

Dentistry

for the Province of Ontario

| Academic Year Beginning | First Year | Retention Rate | Second Year | Retention Rate | Third Year | Retention Rate | Fourth Year | Total |
|---|---|---|---|---|---|---|---|---|
| 1961 | 120 | 103.3333 | 111 | 93.6937 | 113 | 108.8496 | 84 | 551 |
| 1962 | 123 | 95.1220 | 124 | 95.1613 | 104 | 113.4615 | 123 | 601 |
| 1963 | 128 | 97.6563 | 117 | 98.2906 | 118 | 104.2373 | 118 | 481 |
| 1964 | 125 | 99.2000 | 125 | 90.4000 | 115 | 106.0870 | 123 | 488 |
| 1965 | 125 | 95.2000 | 124 | 104.0323 | 113 | 107.9646 | 122 | 484 |
| 1966 | 132 | 100.7576 | 119 | 100.0000 | 129 | 100.0000 | 122 | 502 |
| 1967 | 132 | 103.0303 | 133 | 95.4887 | 119 | 106.7227 | 129 | 513 |
| 1968 | 154 | 96.7532 | 136 | 102.2059 | 127 | 103.1496 | 127 | 544 |
| 1969 | 165 | 96.3636 | 149 | 98.6577 | 139 | 100.0000 | 131 | 584 |
| 1970 | 178 | | 159 | | 147 | | 139 | 623 |

TABLE II-6

Actual Full-Time Undergraduate Enrolment in Provincially Assisted Universities

And Retention Rates

in

Forestry

for the Province of Ontario

| Academic Year Beginning | First Year | Retention Rate | Second Year | Retention Rate | Third Year | Retention Rate | Fourth Year | Total |
|---|---|---|---|---|---|---|---|---|
| 1961 | 36 | 94.4444 | 28 | 71.4286 | 21 | 95.2381 | 18 | 103 |
| 1962 | 32 | 84.3750 | 34 | 70.5882 | 20 | 110.0000 | 20 | 106 |
| 1963 | 22 | 109.0909 | 27 | 85.1852 | 24 | 100.0000 | 22 | 95 |
| 1964 | 26 | 73.0769 | 24 | 100.0000 | 23 | 82.6087 | 24 | 97 |
| 1965 | 31 | 87.0968 | 19 | 68.4211 | 24 | 95.8333 | 19 | 93 |
| 1966 | 52 | 94.2308 | 27 | 70.3704 | 13 | 107.6923 | 23 | 115 |
| 1967 | 72 | 94.4444 | 49 | 81.6327 | 19 | 78.9474 | 14 | 154 |
| 1968 | 82 | 85.3659 | 68 | 82.3529 | 40 | 92.5000 | 15 | 205 |
| 1969 | 98 | 92.8571 | 70 | 81.4286 | 56 | 87.5000 | 37 | 261 |
| 1970 | 110 | | 91 | | 57 | | 49 | 307 |

TABLE II-7

Actual Full-Time Undergraduate Enrolment in Provincially Assisted Universities

And Retention Rates

in

Nursing

for the Province of Ontario

| Academic Year Beginning | First Year | Retention Rate | Second Year | Retention Rate | Third Year | Retention Rate | Fourth Year | Total |
|---|---|---|---|---|---|---|---|---|
| 1961 | 187 | | 110 | | 140 | | 220 | 657 |
| | | 62.0321 | | 211.8182 | | 60.7143 | | |
| 1962 | 198 | | 116 | | 233 | | 85 | 632 |
| | | 67.1717 | | 250.0000 | | 30.9013 | | |
| 1963 | 254 | | 133 | | 290 | | 72 | 749 |
| | | 54.7244 | | 205.2632 | | 40.3448 | | |
| 1964 | 250 | | 139 | | 273 | | 117 | 779 |
| | | 21.9638 | | 174.8201 | | 59.7070 | | |
| 1965 | 239 | | 85 | | 243 | | 163 | 730 |
| | | 58.1590 | | 332.9412 | | 86.0082 | | |
| 1966 | 267 | | 139 | | 283 | | 209 | 898 |
| | | 76.0300 | | 177.6978 | | 74.2049 | | |
| 1967 | 271 | | 203 | | 247 | | 210 | 931 |
| | | 112.1771 | | 99.5074 | | 72.8745 | | |
| 1968 | 341 | | 304 | | 202 | | 180 | 1027 |
| | | 103.8123 | | 74.6711 | | 87.1287 | | |
| 1969 | 393 | | 354 | | 227 | | 176 | 1150 |
| | | 104.5802 | | 72.3164 | | 76.6520 | | |
| 1970 | 439 | | 411 | | 256 | | | 1280 |

TABLE II-8

Actual Full-Time Undergraduate Enrolment in Provincially Assisted Universities and

Retention Rates

in

Pharmacy

for the Province of Ontario

| Academic Year Beginning | First Year | Retention Rate | Second Year | Retention Rate | Third Year | Retention Rate | Fourth Year | Total |
|---|---|---|---|---|---|---|---|---|
| 1961 | 108 | | 121 | | 97 | | 61 | 387 |
| | | 97.2222 | | 86.7769 | | 98.9691 | | |
| 1962 | 103 | | 105 | | 105 | | 96 | 409 |
| | | 104.8544 | | 95.2381 | | 86.6667 | | |
| 1963 | 96 | | 108 | | 100 | | 91 | 395 |
| | | 95.8333 | | 91.6667 | | 95.0000 | | |
| 1964 | 101 | | 92 | | 99 | | 95 | 387 |
| | | 103.9604 | | 89.1304 | | 90.9091 | | |
| 1965 | 134 | | 105 | | 82 | | 90 | 411 |
| | | 105.2239 | | 86.6667 | | 92.6829 | | |
| 1966 | 125 | | 141 | | 91 | | 76 | 433 |
| | | 104.0000 | | 84.4000 | | 91.2088 | | |
| 1967 | 128 | | 130 | | 119 | | 83 | 460 |
| | | 100.7812 | | 98.4615 | | 73.1100 | | |
| 1968 | 136 | | 129 | | 128 | | 87 | 480 |
| | | 97.7941 | | 95.3488 | | 92.1875 | | |
| 1969 | 144 | | 133 | | 123 | | 118 | 518 |
| | | 92.3611 | | 86.4662 | | 94.3089 | | |
| 1970 | 152 | | 133 | | 115 | | 116 | 516 |

TABLE II-9

Actual Full-Time Undergraduate Enrolment in Provincially Assisted Universities and Retention Rates in Veterinary Science for the Province of Ontario

| Academic Year Beginning | First Year | Retention Rate | Second Year | Retention Rate | Third Year | Retention Rate | Fourth Year | Total |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0 | | 0 | | 0 | | 0 | 0 |
| | | .0000 | | .0000 | | .0000 | | |
| 1962 | 0 | | 0 | | 0 | | 0 | 0 |
| | | .0000 | | .0000 | | .0000 | | |
| 1963 | 73 | | 53 | | 64 | | 0 | 269 |
| | | 87.6712 | | 96.2264 | | .0000 | | |
| 1964 | 81 | | 64 | | 51 | | 0 | 276 |
| | | 85.1852 | | 115.6250 | | 123.5294 | | |
| 1965 | 80 | | 69 | | 74 | | 63 | 286 |
| | | 82.5000 | | 95.6522 | | 98.6486 | | |
| 1966 | 63 | | 66 | | 66 | | 73 | 268 |
| | | 103.1746 | | 96.9700 | | 98.4848 | | |
| 1967 | 78 | | 52 | | 64 | | 65 | 259 |
| | | 91.0300 | | 98.0800 | | 98.4400 | | |
| 1968 | 80 | | 71 | | 51 | | 63 | 265 |
| | | 100.0000 | | 97.1831 | | 100.0000 | | |
| 1969 | 80 | | 80 | | 69 | | 51 | 280 |
| | | 100.0000 | | 98.7500 | | 98.5507 | | |
| 1970 | 80 | | 80 | | 79 | | 68 | 307 |

TABLE II-10

Actual Full-Time Undergraduate Enrolment in Provincially Assisted Universities and Retention Rates in General and Honours Arts Brock University

| Academic Year Beginning | First Year | Retention Rate | Second Year | Retention Rate | Third Year | Retention Rate | Fourth Year | Total |
|---|---|---|---|---|---|---|---|---|
| 1961 | 0 | .0000 | 0 | .0000 | 0 | .0000 | 0 | 0 |
| 1962 | 0 | .0000 | 0 | .0000 | 0 | .0000 | 0 | 0 |
| 1963 | 0 | .0000 | 0 | .0000 | 0 | .0000 | 0 | 0 |
| 1964 | 124 | 58.8710 | 0 | .0000 | 0 | .0000 | 0 | 124 |
| 1965 | 208 | 60.5769 | 73 | 73.9726 | 0 | .0000 | 0 | 281 |
| 1966 | 235 | 51.4894 | 126 | 58.7302 | 54 | 25.9259 | 0 | 415 |
| 1967 | 267 | 65.1685 | 121 | 98.3471 | 74 | 33.7838 | 14 | 476 |
| 1968 | 329 | 86.6261 | 174 | 63.7931 | 119 | 45.3782 | 25 | 647 |
| 1969 | 477 | 66.0377 | 285 | 80.0000 | 111 | 58.5586 | 54 | 927 |
| 1970 | 732 | | 315 | | 228 | | 65 | 1340 |

TABLE II-11

Actual Full-Time Undergraduate Enrolment in Provincially Assisted Universities and Retention Rates in General and Honours Arts Queen's University

| Academic Year Beginning | First Year | Retention Rate | Second Year | Retention Rate | Third Year | Retention Rate | Fourth Year | Total |
|---|---|---|---|---|---|---|---|---|
| 1961 | 446 | 102.2422 | 349 | 112.3209 | 323 | 25.0774 | 84 | 1202 |
| 1962 | 330 | 123.3333 | 456 | 98.2456 | 392 | 19.3878 | 81 | 1259 |
| 1963 | 480 | 105.2083 | 407 | 106.3882 | 448 | 23.2143 | 76 | 1411 |
| 1964 | 475 | 117.0526 | 505 | 105.7426 | 433 | 24.9423 | 104 | 1517 |
| 1965 | 604 | 102.6490 | 556 | 99.2806 | 534 | 18.7266 | 108 | 1802 |
| 1966 | 565 | 127 7876 | 620 | 99.6774 | 552 | 16.1232 | 100 | 1837 |
| 1967 | 672 | 116.2202 | 722 | 100.2770 | 618 | 18.2848 | 89 | 2101 |
| 1968 | 759 | 115.6785 | 781 | 97.4392 | 724 | 18.6464 | 113 | 2377 |
| 1969 | 689 | 117.4165 | 878 | 91.2301 | 761 | 21.9448 | 135 | 2463 |
| 1970 | 671 | | 809 | | 801 | | 167 | 2448 |

TABLE II-12

Actual Full-Time Undergraduate Enrolment in Provincially Assisted Universities and Retention Rates in University of Toronto

| Academic Year Beginning | First Year | Retention Rate | Second Year | Retention Rate | Third Year | Retention Rate | Fourth Year | Total |
|---|---|---|---|---|---|---|---|---|
| 1961 | 1702 | | 1387 | | 1082 | | 334 | 4505 |
| | | 85.8402 | | 84.3547 | | 30.3142 | | |
| 1962 | 1684 | | 1461 | | 1170 | | 328 | 4643 |
| | | 97.6841 | | 87.8166 | | 32.9915 | | |
| 1963 | 1899 | | 1645 | | 1283 | | 386 | 5213 |
| | | 87.0985 | | 84.8024 | | 34.6064 | | |
| 1964 | 2011 | | 1654 | | 1395 | | 444 | 5504 |
| | | 92.2427 | | 86.2152 | | 37.2043 | | |
| 1965 | 2158 | | 1855 | | 1426 | | 519 | 5958 |
| | | 88.1835 | | 85.9299 | | 33.5203 | | |
| 1966 | 2207 | | 1903 | | 1594 | | 478 | 6182 |
| | | 91.3457 | | 90.2260 | | 30.7403 | | |
| 1967 | 2568 | | 2016 | | 1717 | | 490 | 6791 |
| | | 71.5732 | | 87.6984 | | 32.2656 | | |
| 1968 | 2095 | | 1838 | | 1768 | | 554 | 6255 |
| | | 167.9236 | | 147.3341 | | 43.3258 | | |
| 1969 | 4247 | | 3518 | | 2708 | | 766 | 11,239 |
| | | 87.5206 | | 87.9761 | | 44.9040 | | |
| 1970 | 4092 | | 3717 | | 2095 | | 1216 | 12,120 |

that the reporting of enrolments is more consistent over time than can generally be expected for other courses. Dentistry and forestry are each taught in only two universities, so in those cases too the problems of consistency in reporting are minimal. Since the enrolment in all these courses is relatively small, the reliability of these retention coefficients does not contribute much to the general quality of data or the aggregate retention rates in university courses.

In general and honours arts the retention rates between the first and second year fluctuate between 81.6 per cent and 101.1 per cent for the universities of the province during the years 1961-70. Between second and third year the range is 88.2 per cent to 108.3 per cent (Table II-2). The retention rates drop notably between third and fourth year due to the large number of students finishing three-year general arts courses.

The general and honour science courses show even greater fluctuation in retention rates (Table II-3). The range is from 55.7 per cent to 104.6 per cent between first and second year. Due to the larger number of students in four year programs, however, there is not a drop between third and fourth year comparable to that for arts.

In engineering and applied science, the University of Ottawa did not report first-year students in 1965. Waterloo reported improbably high second- and third-year enrolment

figures in 1970. Furthermore, retention rates generally have fluctuated considerably over the past five years (Table II-4). It must be conceded that any trend or regularity in the behaviour of these statistics eludes recognition.

Other faculties also show great irregularities in the reported enrolment from year to year. It has been found also that enrolment statistics from all universities are not equally reliable. Furthermore, course definitions are not uniform among the universities, nor are they uniform within one institution over time. In a strict sense, the courses for which retention rates are computed are not always conceptually equivalent over time or across institutions.

Enrolments reported in nursing are extremely irregular. The retention rates from first to second year fluctuate between 22 per cent and 112 per cent, from second to third year between 72 per cent and 333 per cent for the province as a whole (Table II-7).

It is observed also that such courses as fine and applied arts and music have enjoyed such recent popularity that it would be of little use to compute retention rates over a decade. Fine and applied arts, for example, doubled its enrolment between 1968 and 1969, and almost doubled again between 1969 and 1970.

All data problems notwithstanding, it may be noted that there is an important connection between admission requirements

and retention rates. A perusal of Tables II-10 to II-12 indicates that a new university with relatively easy admission requirements can expect higher attrition rates than a well-established university with very demanding admission requirements.

3. Secondary school outputs and post-secondary enrolments

Probably the most important assumptions in any projection of post-secondary enrolments are those bearing upon the relationships between secondary-school output statistics and those enrolment statistics. It is, of course, immediately obvious that this relationship is affected by admission requirements and retention rates.

No set of data would be so helpful to the projecting of university (and to a lesser extent other post-secondary institutions) enrolment as good forecasts of future Grade 13 enrolments and graduates. Forecasts of the proportion of those graduates with average marks of 60 per cent or better would also be invaluable. Unfortunately, the tenuous position of Grade 13 in the Ontario educational system precludes any hope of confidence in such forecasts.

The Hall-Dennis Report (1968) is only one published source of many thoughtful recommendations for the elimination of Grade 13. However, Grade 13 also has its supporters, and it is inappropriate to predict its early disappearance. In the projections that follow, it will be assumed that Grade 13

will survive indefinitely. It is necessary, therefore, to examine statistics relevant to Grade 13's bearing upon first-year university enrolment.

The history of enrolment in Grade 13 is one of nearly continuous expansion. There were, however, significant contractions in 1965-66 and in 1966-67. It is assumed here that these declines were the products of declines in live births in 1948 (Table II-13). Births increased after 1948, so did Grade 13 enrolments after 1967. Table II-13 indicates that live births continued to increase until 1960. The decline in births from 1960 to 1969 indicate that Grade 13 will continue to increase in size until 1978, and then decline, assuming attrition rates in secondary school remain constant.

However, the assumption of the direct relationship between the reduced enrolment in 1966-67 and births in 1948 is open to question. At least two other factors may have contributed to that decline. The first group of students going through high school under the Robarts Plan reached Grade 13 in 1966-67. Also they were the first cohort of Ontario students to have the Colleges of Applied Arts and Technology as an alternative to Grade 13 (though, of course, this was a minor influence because the CAAT system only began to function that year).

In any case, it is apparent that secondary-school programs are becoming increasingly flexible. Whether or not the Robarts

Plan worked to reduce Grade 13 enrolments, this new flexibility is likely to contribute to increased Grade 13 enrolment in the future. Moreover, since the alternatives to Grade 13 (particularly the CAATs) are increasingly important, it is very likely that Grade 13 will become more a preparatory year for university than it has been in very recent years. This suggests that a given Grade 13 enrolment will produce a greater demand for university places the following year than has been the case for some years. This also suggests there will be an increase in the number of Grade 13 students achieving 60 per cent or better averages. This trend is already quite visible, with the proportion of Grade 13 papers on which 60 per cent or higher is obtained rising from 51 per cent in 1966 to 69 per cent in 1968.

This trend will also be supported by the disappearance of teachers' colleges as the direct recipients of Grade 13 graduates. The one major alternative to university that will remain for these graduates will be schools of nursing (which also recruit from Grade 12).

Information necessary to the production of satisfying transition co-efficients from Grade 13 to university first year includes: data on the geographical source of first-year students; the proportion of Ontario university students at Ontario (and other) universities; the proportion of university students from outside the province; the proportion of students who commence

university study immediately after high school, one year, two years later, etc.; and numbers of Ontario students going to university after Grade 12, whether into first year or a preparatory year. No reliable source exists for any of this information.

Such data as is obtainable on Ontario students studying in the U. K., the U. S. and in other provinces is presented in Table II-14. In the accompanying projections it has been assumed that the number of outsiders in Ontario universities as first year students is greater than the number of Ontario students at non-Ontario universities, i.e. Ontario is a net importer of students (see Table II-15). Unfortunately, data are inadequate for even rough estimates of the distribution of incoming (and outgoing) students by year, by faculty and by undergraduate or graduate status.

Data on survival rates through secondary school make it quite clear that they have been steadily improving. The Grade 9 to 13 survival rate rose from 21.60 per cent to 39.75 per cent between 1954 and 1969. That increase has been somewhat slower since 1965, but it must be assumed that this trend continues.

Perhaps data will be adequate in a few years to construct flow co-efficients from Grade 13 to first year university (and beyond). Currently, however, it is only possible to produce these from stock data. And, of course, stock data with many imperfections. Several alternative sets of assumptions about

the flow from Grade 13 to first year were tested. That which produced the "best" or "smoothest" relationship was: 80 per cent of first year students in a given year completed Grade 13 that year; 15 per cent in the previous year; and 5 per cent two years previously.

Tables II-16 and II-17 indicate that the stock data transition rate from Grade 13 to first year university has increased from 76.93 per cent in 1967 to 86.39 per cent in 1970. It is here assumed this will continue to increase to 95 per cent in 1985 and then level off. This very high transition rate depends upon the assumptions that: Ontario will continue to be a net importer of students; some students will go to university from Grade 12; and some will go to university from the Colleges of Applied Arts and Technology.

4. Some comments on university enrolment data and their sources

There are three main sources of data on university enrolments: i) Dominion Bureau of Statistics (DBS); ii) Department of University Affairs; and iii) the individual universities.

Unfortunately, there is less than perfect co-ordination of these sources. As a consequence, there is no standard format, no consistent definition of graduate and undergraduate courses, and no common date of collection.

DBS is perhaps the best of these sources in terms of the quality of its data, but the quantity of information offered on Ontario universities is disappointing. It provides enrol-

TABLE II-13

Live Births in Ontario--1936 to 1968

| Year | Number of Live Births | Year to Reach Age 18 | Year to Reach Age 21 |
|---|---|---|---|
| 1936 | 62,451 | 1954 | 1957 |
| 1937 | 61,645 | 1955 | 1958 |
| 1938 | 65,564 | 1956 | 1959 |
| 1939 | 64,123 | 1957 | 1960 |
| 1940 | 68,524 | 1958 | 1961 |
| 1941 | 72,262 | 1959 | 1962 |
| 1942 | 78,192 | 1960 | 1963 |
| 1943 | 81.173 | 1961 | 1964 |
| 1944 | 78,090 | 1962 | 1965 |
| 1945 | 78,974 | 1963 | 1966 |
| 1946 | 97,446 | 1964 | 1967 |
| 1947 | 108,853 | 1965 | 1968 |
| 1948 | 104,195 | 1966 | 1969 |
| 1949 | 106,601 | 1967 | 1970 |
| 1950 | 108,708 | 1968 | 1971 |
| 1951 | 114,827 | 1969 | 1972 |
| 1952 | 123,891 | 1970 | 1973 |
| 1953 | 129,771 | 1971 | 1974 |
| 1954 | 136,261 | 1972 | 1975 |
| 1955 | 139,553 | 1973 | 1976 |
| 1956 | 143,516 | 1974 | 1977 |
| 1957 | 150,920 | 1975 | 1978 |
| 1958 | 152,637 | 1976 | 1979 |
| 1959 | 157,124 | 1977 | 1980 |
| 1960 | 159,245 | 1978 | 1981 |
| 1961 | 157,663 | 1979 | 1982 |
| 1962 | 156,053 | 1980 | 1983 |
| 1963 | 155,089 | 1981 | 1984 |
| 1964 | 152,729 | 1982 | 1985 |
| 1965 | 141,610 | 1983 | 1986 |
| 1966 | 131,942 | 1984 | 1987 |
| 1967 | 127,509 | 1985 | 1988 |
| 1968 | 127,142 | 1986 | 1989 |

Source: Province of Ontario, Department of the Provincial Secretary and Citizenship, Registrar General Branch, Vital Statistics.

TABLE II-14

Ontario Residents Studying in Universities in Other Provinces and in the U.S. and U. K.

| Academic Year Beginning | (1) Total Enrolment in Ontario Universities | (2) Ontario Residents Studying in Other Provinces | (3) | (4) Ontario Residents Studying in U.K. & U.S.A. | (5) | (6) Total of Other Provinces, U.S. and U.K. | (7) |
|---|---|---|---|---|---|---|---|
| | | Number | (2) as a % of (1) | Number | (4) as a % of (1) | Number (2)+(4) | As a % of (1) |
| 1960 | 32,100 | 2157 | 6.7 | | | | |
| 61 | 35,871 | 2445 | 6.8 | | | | |
| 62 | 39,269 | 2693 | 6.8 | 1450 | 3.7 | 4143 | 10.6 |
| 63 | 44,191 | 2967 | 6.7 | 1705 | 3.9 | 4672 | 10.6 |
| 64 | 50,793 | 3005 | 5.9 | 2239 | 4.4 | 5244 | 10.3 |
| 65 | 58,983 | 3048 | 5.2 | 2768 | 4.7 | 5816 | 9.9 |
| 66 | 68,589 | 3434 | 5.0 | 3715 | 5.4 | 7149 | 10.4 |
| 67 | 79,089 | 3828 | 4.8 | 4560 | 5.8 | 8388 | 10.6 |
| 68 | 92,589 | 4034 | 4.3 | 5604 | 6.1 | 9638 | 10.4 |

Sources: Columns 1, 2 and 3 from D.B.S. Survey of Higher Education. Columns 4 and 5 from: 1. Directory of Canadians Studying in the United Kingdom, Economic & Research Branch, Department of Labour, Canada, up to 1964-65 and Research Branch, Department of Manpower and Immigration, Canada, after 1964-65, 2. Directory of Canadians Studying in the United States, Economics and Research Branch, Department of Labour, Canada, up to 1964-65 and Research Branch, Department of Manpower and Immigration, Canada, after 1964-65.

TABLE II-15

Full Time University Students in Winter Session in Ontario Universities Who Are from Outside Ontario

| Year | From Other Provinces of Canada | From Other Countries | Total |
|---|---|---|---|
| 1960 | 3,145 | 2,612 | 5,757 |
| 1961 | 3,664 | 2,748 | 6,412 |
| 1963 | 4,312 | 3,356 | 7,668 |
| 1964 | 4,469 | 3,477 | 7,946 |
| 1965 | 5,093 | 4,089 | 9,182 |
| 1966 | 5,382 | 4,743 | 10,125 |
| 1967 | 5,675 | 5,578 | 11,253 |
| 1968 | 6,499 | 6,453 | 12,952 |
| 1969 | 7,958 | 7,999 | 15,957 |
| 1970* | 6,194 | 4,055 | 10,249** |

*D.B.S. unpublished data.

**Undergraduate only.

Source: Survey of Higher Education 1965-66; 1966-67; 1967-68 and 1968-69, Part II, Cat. No. 81-211 and 1969-70, Part I, Cat. No. 81-204.

TABLE II-16

June Graduates as a Percentage of Grade 13 Enrolment in the Preceeding Fall and the Adjusted Pool of Grade 13 Graduates[1]

| Year | Grade 13 Enrolment | Grade 13 Graduates | Graduates as a % of Grade 13 | Adjusted Pool of Grade 13 Graduates Plus Preliminary Students |
|---|---|---|---|---|
| 1961 | 21,482 | n.a. | | |
| 1962 | 23,750 | n.a. | | |
| 1963 | 26,262 | n.a. | | |
| 1964 | 32,770 | n.a. | | |
| 1965 | 37,690 | 22,961 | 70.07 | |
| 1966 | 35,007 | 28,489 | 75.59 | |
| 1967 | 36,472 | 26,500 | 75.70 | 27,647 |
| 1968 | 40,087 | 32,492 | 89.09 | 32,314 |
| 1969 | 43,569 | 34,748 | 86.68 | 34,905 |
| 1970 | 48,173 | 36,597 | 84.00 | 37,024 |
| 1971 | 52,384 | 40,947 | 85.00 | 40,985 |
| 1972 | 55,086 | 45,312 | 86.50 | 45,222 |
| 1973 | 57,833 | 47,649 | | 47,963 |
| 1974 | 59,605 | 50,025 | | 50,433 |
| 1975 | 62,168 | 51,558 | | 52,132 |
| 1976 | 64,988 | 53,775 | | 54,255 |
| 1977 | 67,086 | 56,215 | | 56,616 |
| 1978 | 69,451 | 58,029 | | 58,544 |
| 1979 | 69,753 | 60,075 | | 60,575 |
| 1980 | 69,718 | 60,336 | | 61,181 |
| 1985 | 55,034 | 60,306 | | 54,915 |
| 1990 | 57,165 | 47,604 | | 48,150 |

[1]Adjusted pool of Grade 13 students equals:
80% of those completing Grade 13 in June of the same year, plus
15% of those completing Grade 13 in June one year previously, plus
5% of those completing Grade 13 in June two years previously.

TABLE II-17

First Year University Enrolment as a Percentage of

Adjusted Pool of Grade 13 Graduates[1]

| Year | Adjusted Pool of Grade 13 Graduates | First Year University Enrolment | First Year University Enrolment as a % of Adjusted Pool of Grade 13 Graduates Plus Preliminary Students |
|---|---|---|---|
| 1961 | | 8,345 | |
| 1962 | | 8,925 | |
| 1963 | | 11,154 | |
| 1964 | | 13,184 | |
| 1965 | | 15,997 | |
| 1966 | | 19,088 | |
| 1967 | 27,647 | 21,269 | 76.93 |
| 1968 | 32,314 | 25,129 | 77.77 |
| 1969 | 34,905 | 29,570 | 84.72 |
| 1970 | 37,024 | 31,986 | 86.39 |
| 1971 | 40,985 | 35,862 | 87.5 |
| 1972 | 45,222 | 39,795 | 88.0 |
| 1973 | 47,963 | 42,447 | 88.5 |
| 1974 | 50,433 | 45,390 | 90.0 |
| 1975 | 52,132 | 47,179 | 90.5 |
| 1976 | 54,255 | 49,372 | 91.0 |
| 1977 | 56,616 | 51,804 | 91.5 |
| 1978 | 58,544 | 53,860 | 92.0 |
| 1979 | 60,575 | 56,031 | 92.5 |
| 1980 | 61,181 | 56,898 | 93.0 |
| 1985 | 54,915 | 52,169 | 95.0 |
| 1990 | 48,150 | 45,743 | 95.0 |

[1] Adjusted pool of Grade 13 students equals:
80% of those completing Grade 13 in June of the same year, plus 15% of those completing Grade 13 in June one year previously, plus 5% of those completing Grade 13 in June two years previously.

ment data by sex, faculty, and institution. Unfortunately, it does not provide data by year of study. Other limitations of this data source are:

(1) definitions are subject to change over the years;

(2) some diploma courses comparable to CAAT programs are included with undergraduate enroments (e.g., diploma courses at Lakehead University);

(3) information is not provided by semester for universities which operate year round;

(4) some graduate courses (e.g., M. A. in social work and other first professional degree courses) are sometimes included with undergraduate courses; this is a particularly serious problem when it is desired to project enrolments as a function of the 18-21 age group.

Some improvements are to come soon. In the future, enrolment figures will be given for first year. There is not, however, any intention of providing data for each year of study.

The data from the Department of University Affairs has as its main limitation its lack of congruence with DBS or other longer-run data, particularly in regard to definitions, data formats and dates of collection.

In addition, it must be admitted that in some universities the variances in enrolments by year and faculty are so erratic as to raise questions about the utility of this information, the lack of which was previously mentioned as a weakness of

DBS data. Such erratic enrolment patterns, of course, may reflect nothing more than peculiarities of the normal progress of students through particular programs. As an example, in some universities we find no students in first and second year for some courses but a year or two later considerable enrolments in third or fourth year, or markedly fewer students in first and second year than in third or fourth year (see Table II-18).

Direct data from the universities is not easy to come by. Some universities, such as the University of Toronto, publish copious quantities of reliable statistics every year about their students. Other universities publish very little, and are quite reluctant to part with compilations of or statements about such data as they have.

Some universities demonstrate peculiarities in their definitions of graduate and undergraduate programs which set them apart from the others, from DBS, and from the Department of University Affairs.

There is no hope that the information from these three major data sources can be made compatible and turned into a single data pool. Depending upon the questions one is dealing with, he must ordinarily exploit one or the other of them. For some purposes one is better, for other purposes another. DBS has data differentiated by sex; University Affairs has data by year of study; neither has both. It is appropriate, therefore, to

resort to the one or the other depending upon the relative value of sex-specific or year-specific data in the answering of questions at hand.

Finally, the woeful reality must be recorded that all of the sources fail to provide the important information listed below. However, the fact that in regard to many of these items one or more institutions does provide it suggests that there are possibilities for better information in the future.

(1) origin (geographical or institutional) of first year students;

(2) year of Grade 13 graduation for all students;

(3) number of students by year of study, faculty from other provinces, countries;

(4) number of Ontario students studying outside the province by year of study, faculty;

(5) socio-economic background of students;

(6) educational background (courses taken, grades) of students;

(7) number of interfaculty transfers;

(8) interuniversity transfers;

(9) age of students, by year of study, faculty;

(10) failure rates, by sex, by year, by faculty;

(11) background of dropouts;

(12) motivation for dropping out.

In connection with (3) and (4), Table II-14 gives such information as can be obtained. It indicates the increase in

numbers of Ontario students studying in the U. S. This appears to be balanced by the declining propensity of Ontario students to study in other provinces.

Table II-15 shows that the numbers of non-Ontario students are increasing, though not as rapidly as are total enrolments, and seems to justify the supposition above (Section 3) that Ontario will remain a net importer of students.

D. Methodology for Projections: A Pragmatic Selection

As mentioned above (Section B), the exploitation of the best available statistical techniques in projecting enrolments must await the implementation of computerized flow models of the movement of the student population through the educational system. In the meantime, people doing these projections must choose among the methods and data sources available and produce some "future statistics", accompanied by such *caveats* as they feel are necessary.

1. Methods of university enrolment projections

The projections of university enrolments produced here are estimates of future "demand" for places or, more accurately, estimates of future numbers of people in specified age groups desiring admission to universities and possessing the required qualifications. It would be as correct to say that these are *ex ante* supply estimates, i.e., estimates of the potential supply of students. This is true also of the estimates of other types of post-secondary enrolments.

TABLE II-18

Actual Full-Time Undergraduate Enrolment

in Nursing at the University of Ottawa

| Year | First Year | Second Year | Third Year | Fourth Year | Total |
|---|---|---|---|---|---|
| 1961 | 20 | - | - | 170 | 190 |
| 1962 | 15 | - | 176 | 42 | 233 |
| 1963 | 35 | - | 192 | 34 | 261 |
| 1964 | 29 | - | 152 | 38 | 219 |
| 1965 | 37 | - | 119 | 66 | 222 |
| 1966 | 25 | - | 135 | 84 | 244 |
| 1967 | 30 | 31 | 1 | 109 | 171 |
| 1968 | 40 | 32 | 26 | 60 | 158 |
| 1969 | 38 | 55 | 28 | 56 | 177 |
| 1970 | 46 | 55 | 49 | 26 | 176 |

Two sets of university enrolment projections have been produced. The two sets of results are presented in two separate sets of tables below, referred to here as Set 1 and Set 2.

The results of Set 1 are the product of extrapolations based upon enrolment data for provincially assisted universities from the Department of University Affairs (except where otherwise specified). The definition of graduate and undergraduate programs and other definitions are according to those of that department. A flow model was used for Set 1, but not for Set 2, since only the University Affairs data could be broken down by year.

The projected enrolments in Set 2 are based upon data for all universities in Ontario from the Dominion Bureau of Statistics. Definitions are those of the Bureau. Population estimates for both sets are those of the Department of Treasury and Economics. The population projections upon which our enrolment projections are based are given in Table II-19.

a. Set 1 projections: In Set 1, the procedure was as follows:

i. first-year enrolment, total and by faculty:

(1) The numbers of Grade 13 graduates were projected to 1990, on the basis of past trends in secondary school enrolment and the ratio of graduates to enrolment. The numbers of graduates are shown in Table II-16 in Section C.

TABLE II-19

Ontario Population Estimates and Projections

(in thousands)

| Year | Age 18 | Age 19 | Age-Group 18-21 | Age-Group 18-24 | Population |
|---|---|---|---|---|---|
| 1970 | 135.2 | 133.3 | 530.4 | 902.7 | 7,636.6 |
| 1971 | 139.2 | 136.8 | 545.6 | 934.8 | 7,780.9 |
| 1972 | 143.7 | 140.6 | 560.4 | 963.5 | 7,921.1 |
| 1973 | 148.7 | 144.8 | 575.9 | 989.6 | 8,054.9 |
| 1974 | 153.8 | 149.8 | 593.7 | 1,016.5 | 8,192.0 |
| 1975 | 158.4 | 155.0 | 612.6 | 1,044.5 | 8,332.5 |
| 1976 | 162.2 | 159.5 | 631.1 | 1,073.5 | 8,476.1 |
| 1977 | 165.3 | 163.3 | 647.7 | 1,102.8 | 8,623.0 |
| 1978 | 167.8 | 166.5 | 661.8 | 1,131.2 | 8,773.0 |
| 1979 | 169.3 | 168.9 | 672.6 | 1,156.6 | 8,926.2 |
| 1980 | 167.3 | 170.5 | 677.8 | 1,175.3 | 9,082.2 |
| 1981 | 170.3 | 168.4 | 682.7 | 1,191.6 | 9,241.0 |
| 1986 | 146.7 | 151.5 | 614.9 | 1,146.4 | 9,601.8 |
| 1991 | 139.0 | 135.8 | 563.4 | 1,030.0 | 10,320.6 |
| 1996 | 160.0 | 156.3 | 630.9 | 1,073.5 | 10,999.4 |
| 2001 | 178.2 | 175.9 | 709.4 | 1,214.4 | 11,655.4 |

Source: Projections for 1970-81 are taken from Ontario Department of Treasury and Economics, Ontario Short Term Population Projections, 1970-1981. Toronto, September, 1970 (Table 2: Most Probable Projections). These projections assume net migrations of: 70,000 for 1970-71; 60,000 for 1971-72; and 50,000 annually for 1973-81. For the period 1981-90, the population projections come from unpublished work of the Department of Treasury and Economics based on Fertility Assumption "B" and assuming net migration of 50,000 per annum.

(2) The annual numbers of Grade 13 graduates were modified to obtain estimates of annual potential first-year university enrolment by assuming that in the case of Ontario students in Ontario universities, 80% graduate the same year as entering university, 15% the year before, and 5% two years before. The modified figures plus the number of preliminary students are shown in the last column of Table II-16.

(3) The numbers from (2) were considered as the potential supply of first-year students from Ontario Grade 13 and preliminary students. Trends in the ratio of actual first-year university enrolment to this potential supply were projected. The projected ratios were applied to the projected annual potential supplies of students for each year to 1990, and the resulting number regarded as the projected actual supply for first-year students. These ratios and numbers are given in Table II-17.

(4) The numbers from (3) were used to produce estimates of future enrolments in the faculties for which Grade 13 is the standard preparation. This distribution of first-year enrolment across faculties was based upon an observation of trends in the enrolment in those faculties over the past ten years. Included here are only those faculties for which admission requirements are Grade 13. The results are presented in Tables II-20 through II-39.

ii. <u>undergraduate enrolment projection by year and faculty</u>:

The projected numbers of first-year students for every year to 1990 provided the bases for calculating the total enrolments for each year to 1990. On the basis of recent experience, coefficients indicating the survival rates from first year to second year, second to third, etc., were calculated and applied to the enrolment data for each class for each year to produce the estimates of enrolment in these classes in the subsequent years. The summation of those separate class enrolments is considered the total enrolment for each year. The enrolments by faculty and by year are given in Tables II-20 through II-39. The aggregate enrolment of these faculties is given as Estimate 1-A in Table II-40/1. Table II-40/2 gives projections derived from applying the survival method to the aggregate first-year enrolment. The projection of the sums is close to, but not equal to, the sum of the projections.

iii. <u>total undergraduate enrolment as a percentage of population aged 18-21</u>:

Total undergraduate enrolment for the province was also projected separately, using the participation rate of the age group 18-21. The extrapolations were based on data for the past ten years. The results are presented in Table II-41, as Estimate 1-B.

iv. <u>total enrolment as a percentage of population aged 18-24</u>:

The method used was the same as described above. The results are presented in Table II-42, Estimate 1-C.

TABLE II-20

Projected Full-Time Undergraduate Enrolment in General and Honours Arts for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 20,115 | 14,548 | 13,687 | 3,314 | | 51,664 |
| 1972 | P | 22,535 | 17,098 | 13,821 | 3,969 | | 57,423 |
| 1973 | R | 24,175 | 19,155 | 16,243 | 4,008 | | 63,581 |
| 1974 | O | 25,810 | 20,548 | 18,197 | 4,710 | | 69,165 |
| 1975 | J | 26,790 | 21,938 | 19,520 | 5,277 | | 73,535 |
| 1976 | E | 28,105 | 23,039 | 20,841 | 5,661 | | 77,646 |
| 1977 | C | 29,585 | 24,170 | 21,887 | 6,044 | | 81,686 |
| 1978 | T | 30,855 | 25,443 | 22,961 | 6,347 | | 85,606 |
| 1979 | E | 32,145 | 26,535 | 24,171 | 6,659 | | 89,510 |
| 1980 | D | 32,625 | 27,645 | 25,208 | 7,009 | | 92,487 |
| 1985 | | 29,620 | 28,174 | 27,243 | 7,814 | | 92,851 |
| 1990 | | 25,280 | 20,980 | 19,767 | 5,828 | | 71,855 |

The projections in Tables II-20 through II-39 are based on Department of University Affairs data and were made using the survival method discussed in the text.

TABLE 11-21

Projected Full-Time Undergraduate Enrolment in General and Honours Science for the Province of Ontario

| Academic Year beginning | | First year | Second year | Third year | Fourth year | Fifth year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 7,170 | 5,543 | 4,293 | 2,009 | | 19,015 |
| 1972 | P | 8,000 | 6,453 | 4,545 | 2,275 | | 21,273 |
| 1973 | R | 8,490 | 7,200 | 5.324 | 2,409 | | 23,423 |
| 1974 | O | 9,080 | 7,641 | 5,940 | 2,822 | | 25,483 |
| 1975 | J | 9,435 | 8,172 | 6,342 | 3,148 | | 27,097 |
| 1976 | E | 9,875 | 8,492 | 6,783 | 3,361 | | 28,511 |
| 1977 | C | 10,360 | 8,887 | 7,091 | 3.595 | | 29,933 |
| 1978 | T | 10,770 | 9,324 | 7,421 | 3,758 | | 31,273 |
| 1979 | E | 11,205 | 9,693 | 7,785 | 3,933 | | 32,616 |
| 1980 | D | 11,380 | 10,085 | 8,094 | 4,126 | | 33,685 |
| 1985 | | 10,440 | 10,224 | 8,739 | 4,600 | | 34,003 |
| 1990 | | 9,140 | 7,992 | 6,668 | 3,582 | | 27,382 |

TABLE II-22

Projected Full-Time Undergraduate Enrolment in Agriculture for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 285 | 222 | 200 | 212 | | 919 |
| 1972 | | 290 | 228 | 167 | 190 | | 875 |
| 1973 | P | 280 | 235 | 171 | 159 | | 845 |
| 1974 | R | 280 | 227 | 176 | 162 | | 845 |
| 1975 | O | 280 | 230 | 170 | 167 | | 847 |
| 1976 | J | 280 | 232 | 173 | 161 | | 846 |
| 1977 | E | 280 | 232 | 174 | 164 | | 850 |
| 1978 | C | 280 | 232 | 174 | 165 | | 851 |
| 1979 | T | 280 | 232 | 174 | 165 | | 851 |
| 1980 | E | 280 | 232 | 174 | 165 | | 851 |
| 1985 | D | 230 | 208 | 174 | 165 | | 777 |
| 1990 | | 230 | 191 | 143 | 136 | | 700 |

TABLE II-23

Projected Full-Time Undergraduate Enrolment in Architecture for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 250 | 205 | 195 | 102 | 48 | 800 |
| 1972 | P | 280 | 225 | 174 | 171 | 71 | 921 |
| 1973 | R | 305 | 252 | 202 | 156 | 137 | 1,052 |
| 1974 | O | 335 | 275 | 226 | 182 | 125 | 1,143 |
| 1975 | J | 370 | 301 | 247 | 203 | 146 | 1,267 |
| 1976 | E | 395 | 333 | 271 | 222 | 162 | 1,383 |
| 1977 | C | 415 | 356 | 300 | 244 | 178 | 1,493 |
| 1978 | T | 430 | 374 | 320 | 270 | 195 | 1,589 |
| 1979 | E | 445 | 387 | 337 | 288 | 216 | 1,673 |
| 1980 | D | 455 | 401 | 348 | 303 | 230 | 1,737 |
| 1985 | | 420 | 401 | 369 | 335 | 268 | 1,793 |
| 1990 | | 360 | 315 | 283 | 255 | 216 | 1,429 |

TABLE II-24

Projected Full-Time Undergraduate Enrolment in Commerce and Business for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 1,200 | 948 | 759 | 680 | | 3,587 |
| 1972 | P | 1,275 | 996 | 853 | 659 | | 3,783 |
| 1973 | R | 1,325 | 1,058 | 896 | 460 | | 3,919 |
| 1974 | O | 1,375 | 1,100 | 952 | 672 | | 4,099 |
| 1975 | J | 1,400 | 1,141 | 990 | 714 | | 4,245 |
| 1976 | E | 1,440 | 1,162 | 1,027 | 742 | | 4,371 |
| 1977 | C | 1,475 | 1,195 | 1,046 | 770 | | 4,486 |
| 1978 | T | 1,500 | 1,224 | 1,075 | 784 | | 4,583 |
| 1979 | E | 1,500 | 1,245 | 1,102 | 806 | | 4,653 |
| 1980 | D | 1,500 | 1,245 | 1,120 | 826 | | 4,691 |
| 1985 | | 1,400 | 1,204 | 1,120 | 840 | | 5,564 |
| 1990 | | 1,300 | 1,058 | 952 | 728 | | 4,038 |

TABLE II-25

Projected Full-Time Undergraduate Enrolment in Dentistry
for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 185 | 172 | 156 | 148 | | 661 |
| 1972 | | 185 | 178 | 168 | 158 | | 689 |
| 2973 | P | 185 | 178 | 174 | 170 | | 707 |
| 1974 | R | 185 | 178 | 174 | 176 | | 713 |
| 1975 | O | 185 | 178 | 174 | 176 | | 713 |
| 1976 | J | 185 | 178 | 174 | 176 | | 713 |
| 1977 | E | 185 | 178 | 174 | 176 | | 713 |
| 1978 | C | 185 | 178 | 174 | 176 | | 713 |
| 1979 | T | 185 | 178 | 174 | 176 | | 713 |
| 1980 | E | 185 | 178 | 174 | 176 | | 713 |
| 1985 | D | 185 | 178 | 174 | 176 | | 713 |
| 1990 | | 185 | 178 | 174 | 176 | | 713 |

TABLE II-26

Projected Full-Time Undergraduate Enrolment in Engineering and Applied Science for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 2,700 | 2,279 | 2,208 | 1,833 | | 9,020 |
| 1972 | P | 2,850 | 2,349 | 2,028 | 1,877 | | 9,104 |
| 1973 | R | 3,000 | 2,480 | 2,091 | 1,724 | | 9,295 |
| 1974 | O | 3,150 | 2,610 | 2,207 | 1,777 | | 9,744 |
| 1975 | J | 3,300 | 2,741 | 2,323 | 1,876 | | 10,240 |
| 1976 | E | 3,450 | 2,871 | 2,439 | 1,975 | | 10,735 |
| 1977 | C | 3,600 | 3,002 | 2,555 | 2,073 | | 11,230 |
| 1978 | T | 3,750 | 3,132 | 2,672 | 2,172 | | 11,726 |
| 1979 | E | 3,900 | 3,263 | 2,787 | 2,271 | | 12,221 |
| 1980 | D | 4,000 | 3,393 | 2,904 | 2,369 | | 12,666 |
| 1985 | | 4,000 | 3,480 | 3,097 | 2,632 | | 13,209 |
| 1990 | | 4,000 | 3,480 | 3,097 | 2,632 | | 13,209 |

TABLE II-27

Projected Full-Time Undergraduate Enrolment in Fine and Applied Arts for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 575 | 449 | 295 | 95 | | 1,414 |
| 1972 | P | 675 | 546 | 436 | 156 | | 1,813 |
| 1973 | R | 765 | 641 | 530 | 231 | | 2,167 |
| 1974 | O | 860 | 727 | 622 | 281 | | 2,490 |
| 1975 | J | 945 | 817 | 705 | 330 | | 2,797 |
| 1976 | E | 990 | 898 | 792 | 374 | | 3,054 |
| 1977 | C | 1,035 | 941 | 871 | 420 | | 3,267 |
| 1978 | T | 1,075 | 983 | 913 | 462 | | 3,433 |
| 1979 | E | 1,110 | 1,021 | 953 | 484 | | 3,568 |
| 1980 | D | 1,135 | 1,055 | 990 | 505 | | 3,685 |
| 1985 | | 1,040 | 1,059 | 1,055 | 561 | | 3,715 |
| 1990 | | 910 | 845 | 811 | 435 | | 3,001 |

TABLE II-28

Projected Full-Time Undergraduate Enrolment in Household Science for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | PROJECTED | 395 | 261 | 195 | 192 | | 1,043 |
| 1972 | | 440 | 296 | 250 | 156 | | 1,142 |
| 1973 | | 465 | 330 | 284 | 203 | | 1,282 |
| 1974 | | 490 | 349 | 317 | 230 | | 1,386 |
| 1975 | | 520 | 368 | 335 | 257 | | 1,480 |
| 1976 | | 545 | 390 | 353 | 271 | | 1,559 |
| 1977 | | 570 | 409 | 374 | 286 | | 1,639 |
| 1978 | | 590 | 428 | 393 | 303 | | 1,714 |
| 1979 | | 615 | 443 | 411 | 318 | | 1,787 |
| 1980 | | 625 | 461 | 425 | 333 | | 1,844 |
| 1985 | | 520 | 428 | 428 | 361 | | 1,737 |
| 1990 | | 460 | 330 | 317 | 262 | | 1,369 |

TABLE II-29

Projected Full-Time Undergraduate Enrolment in Forestry for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 115 | 102 | 74 | 51 | | 342 |
| 1972 | P | 125 | 107 | 83 | 67 | | 382 |
| 1973 | R | 140 | 118 | 87 | 76 | | 421 |
| 1974 | O | 155 | 133 | 96 | 80 | | 464 |
| 1975 | J | 165 | 145 | 108 | 88 | | 506 |
| 1976 | E | 180 | 156 | 118 | 99 | | 553 |
| 1977 | C | 190 | 168 | 127 | 108 | | 593 |
| 1978 | T | 205 | 180 | 137 | 117 | | 639 |
| 1979 | E | 220 | 193 | 147 | 126 | | 686 |
| 1980 | D | 230 | 205 | 157 | 135 | | 727 |
| 1985 | | 230 | 216 | 176 | 162 | | 784 |
| 1990 | | 230 | 216 | 176 | 162 | | 784 |

TABLE II-30

Projected Full-Time Undergraduate Enrolment in Journalism for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 145 | 123 | 77 | 8 | | 353 |
| 1972 | | 155 | 146 | 86 | 9 | | 396 |
| 1973 | P | 170 | 156 | 117 | 12 | | 455 |
| 1974 | R | 180 | 171 | 125 | 12 | | 488 |
| 1975 | O | 190 | 181 | 137 | 14 | | 522 |
| 1976 | J | 200 | 192 | 145 | 15 | | 552 |
| 1977 | E | 210 | 202 | 154 | 15 | | 581 |
| 1978 | C | 220 | 212 | 162 | 16 | | 610 |
| 1979 | T | 225 | 222 | 170 | 17 | | 634 |
| 1980 | E | 230 | 227 | 177 | 18 | | 652 |
| 1985 | D | 210 | 222 | 185 | 19 | | 636 |
| 1990 | | 180 | 181 | 145 | 15 | | 521 |

TABLE II-31

Projected Full-Time Undergraduate Enrolment in Law for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 1,285 | 949 | 826 | | | 3,060 |
| 1972 | | 1,449 | 1,070 | 931 | | | 3,450 |
| 1973 | P | 1,625 | 1,200 | 1,045 | | | 3,870 |
| 1974 | R | 1,827 | 1,348 | 1,175 | | | 4,350 |
| 1975 | O | 2,037 | 1,504 | 1,309 | | | 4,850 |
| 1976 | J | 2,272 | 1,677 | 1,461 | | | 5,410 |
| 1977 | E | 2,486 | 1,835 | 1,599 | | | 5,920 |
| 1978 | C | 2,667 | 1,969 | 1,714 | | | 6,350 |
| 1979 | T | 2,835 | 2,093 | 1,822 | | | 6,750 |
| 1980 | E | 2,982 | 2,201 | 1,917 | | | 7,100 |
| 1985 | D | 3,385 | 2,492 | 2,163 | | | 8,040 |
| 1990 | | 3,633 | 2,682 | 2,335 | | | 8,650 |

TABLE II-32

Projected Full-Time Undergraduate Enrolment in Medicine
for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 505 | 523 | 441 | 410 | | 1,850 |
| 1972 | | 525 | 523 | 488 | 422 | | 1,958 |
| 1973 | P | 535 | 525 | 417 | 451 | | 2,028 |
| 1974 | R | 545 | 531 | 519 | 462 | | 2,057 |
| 1975 | O | 545 | 531 | 525 | 464 | | 2,065 |
| 1976 | J | 545 | 531 | 525 | 470 | | 2,071 |
| 1977 | E | 545 | 531 | 525 | 470 | | 2,071 |
| 1978 | C | 545 | 531 | 525 | 470 | | 2,071 |
| 1979 | T | 545 | 531 | 525 | 470 | | 2,071 |
| 1980 | E | 545 | 531 | 525 | 470 | | 2,071 |
| 1985 | D | 545 | 531 | 525 | 470 | | 2,071 |
| 1990 | | 545 | 531 | 525 | 470 | | 2,071 |

TABLE II-33

Projected Full-Time Undergraduate Enrolment in Music for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 290 | 229 | 175 | 158 | | 852 |
| 1972 | | 320 | 247 | 198 | 158 | | 923 |
| 1973 | P | 360 | 272 | 213 | 178 | | 1,023 |
| 1974 | R | 400 | 306 | 235 | 192 | | 1,133 |
| 1975 | O | 425 | 340 | 265 | 211 | | 1,241 |
| 1976 | J | 445 | 361 | 294 | 239 | | 1,339 |
| 1977 | E | 465 | 378 | 312 | 264 | | 1,419 |
| 1978 | C | 485 | 395 | 327 | 281 | | 1,488 |
| 1979 | T | 505 | 412 | 342 | 294 | | 1,553 |
| 1980 | E | 510 | 429 | 356 | 308 | | 1,603 |
| 1985 | D | 470 | 434 | 382 | 344 | | 1,630 |
| 1990 | | 410 | 340 | 294 | 265 | | 1,309 |

TABLE II-34

Projected Full-Time Undergraduate Enrolment in Nursing for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 505 | 452 | 329 | 205 | | 1,491 |
| 1972 | | 560 | 520 | 366 | 263 | | 1,709 |
| 1973 | P | 595 | 571 | 426 | 293 | | 1,885 |
| 1974 | R | 650 | 595 | 468 | 341 | | 2,054 |
| 1975 | O | 710 | 650 | 494 | 374 | | 2,228 |
| 1976 | J | 740 | 710 | 539 | 395 | | 2,384 |
| 1977 | E | 770 | 740 | 603 | 431 | | 2,544 |
| 1978 | C | 810 | 770 | 629 | 482 | | 2,691 |
| 1979 | T | 840 | 810 | 654 | 503 | | 2,807 |
| 1980 | E | 850 | 840 | 688 | 523 | | 2,901 |
| 1985 | D | 780 | 850 | 731 | 585 | | 2,946 |
| 1990 | | 690 | 670 | 561 | 455 | | 2,376 |

TABLE II-35

Projected Full-Time Undergraduate Enrolment in Pharmacy for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 160 | 144 | 117 | 108 | | 529 |
| 1972 | | 170 | 152 | 127 | 110 | | 559 |
| 1973 | P | 175 | 165 | 137 | 119 | | 596 |
| 1974 | R | 180 | 170 | 149 | 129 | | 628 |
| 1975 | O | 190 | 175 | 153 | 140 | | 658 |
| 1976 | J | 200 | 184 | 158 | 144 | | 686 |
| 1977 | E | 210 | 194 | 166 | 149 | | 719 |
| 1978 | C | 215 | 204 | 175 | 156 | | 750 |
| 1979 | T | 225 | 209 | 184 | 166 | | 784 |
| 1980 | E | 230 | 218 | 188 | 173 | | 809 |
| 1985 | D | 210 | 223 | 200 | 188 | | 821 |
| 1990 | | 180 | 175 | 158 | 148 | | 661 |

TABLE II-36

Projected Full-Time Undergraduate Enrolment in Physical and Health Education for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 1,475 | 1,129 | 1,042 | 787 | | 4,433 |
| 1972 | P | 1,575 | 1,180 | 1,072 | 938 | | 4,765 |
| 1973 | R | 1,600 | 1,260 | 1,121 | 1,018 | | 4,999 |
| 1974 | O | 1,720 | 1,280 | 1,197 | 1,065 | | 5,262 |
| 1975 | J | 1,780 | 1,376 | 1,216 | 1,137 | | 5,509 |
| 1976 | E | 1,850 | 1,424 | 1,307 | 1,155 | | 5,736 |
| 1977 | C | 1,900 | 1,480 | 1,353 | 1,242 | | 5,975 |
| 1978 | T | 1,950 | 1,520 | 1,406 | 1,285 | | 6,161 |
| 1979 | E | 2,000 | 1,560 | 1,444 | 1,336 | | 6,340 |
| 1980 | D | 2,050 | 1,600 | 1,482 | 1,372 | | 6,504 |
| 1985 | | 1,880 | 1,608 | 1,558 | 1,488 | | 6,534 |
| 1990 | | 1,650 | 1,280 | 1,208 | 1,155 | | 5,293 |

TABLE II-37

Projected Full-Time Undergraduate Enrolment in Secretarial Science for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 130 | 87 | 52 | | | 269 |
| 1972 | | 150 | 112 | 70 | | | 332 |
| 1973 | P | 165 | 129 | 91 | | | 385 |
| 1974 | R | 180 | 142 | 106 | | | 428 |
| 1975 | O | 190 | 155 | 116 | | | 461 |
| 1976 | J | 200 | 163 | 127 | | | 490 |
| 1977 | E | 210 | 172 | 134 | | | 516 |
| 1978 | C | 220 | 181 | 141 | | | 542 |
| 1979 | T | 225 | 189 | 148 | | | 562 |
| 1980 | E | 230 | 194 | 155 | | | 579 |
| 1985 | D | 210 | 198 | 162 | | | 570 |
| 1990 | | 180 | 155 | 127 | | | 462 |

TABLE II-38

Projected Full-Time Undergraduate Enrolment in Veterinary Science for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 80 | 80 | 78 | 77 | | 315 |
| 1972 | | 80 | 80 | 78 | 77 | | 315 |
| 1973 | P | 80 | 80 | 78 | 77 | | 315 |
| 1974 | R | 80 | 80 | 78 | 77 | | 315 |
| 1975 | O | 80 | 80 | 78 | 77 | | 315 |
| 1976 | J | 80 | 80 | 78 | 77 | | 315 |
| 1977 | E | 80 | 80 | 78 | 77 | | 315 |
| 1978 | C | 80 | 80 | 78 | 77 | | 315 |
| 1979 | T | 80 | 80 | 78 | 77 | | 315 |
| 1980 | E | 80 | 80 | 78 | 77 | | 315 |
| 1985 | D | 80 | 80 | 78 | 77 | | 315 |
| 1990 | | 80 | 80 | 78 | 77 | | 315 |

TABLE II-39

Projected Full-Time Undergraduate Enrolment in Social Work for the Province of Ontario

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 215 | 154 | 117 | 128 | | 614 |
| 1972 | | 240 | 172 | 148 | 117 | | 677 |
| 1973 | P | 255 | 192 | 165 | 148 | | 760 |
| 1974 | R | 275 | 204 | 184 | 165 | | 828 |
| 1975 | O | 285 | 220 | 196 | 184 | | 885 |
| 1976 | J | 295 | 228 | 211 | 196 | | 930 |
| 1977 | E | 310 | 236 | 219 | 211 | | 976 |
| 1978 | C | 325 | 248 | 227 | 219 | | 1,019 |
| 1979 | T | 335 | 260 | 238 | 227 | | 1,060 |
| 1980 | E | 340 | 268 | 250 | 238 | | 1,096 |
| 1985 | D | 310 | 272 | 261 | 261 | | 1,104 |
| 1990 | | 270 | 216 | 200 | 207 | | 893 |

TABLE II-40/1

Full-Time Undergraduate Enrolment[a] in Provincially Supported Universities for the Province of Ontario

Estimate 1-A/1

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1971 | | 35,725 | 26,875 | 23,815 | 9,882 | 48 | 96,345 |
| 1972 | | 39,640 | 30,827 | 24,424 | 11,115 | 71 | 106,077 |
| 1973 | P | 42,265 | 34,214 | 28,098 | 11,374 | 137 | 116,088 |
| 1974 | R | 45,120 | 36,478 | 31,197 | 12,820 | 125 | 125,740 |
| 1975 | O | 46,975 | 38,950 | 33,317 | 14,120 | 146 | 133,508 |
| 1976 | J | 49,190 | 40,835 | 35,578 | 15,010 | 162 | 140,775 |
| 1977 | E | 51,585 | 42,762 | 37,366 | 16,016 | 178 | 147,907 |
| 1978 | C | 53,680 | 44,850 | 39,133 | 16,817 | 195 | 154,675 |
| 1979 | T | 55,775 | 46,674 | 41,047 | 17,593 | 216 | 161,305 |
| 1980 | E | 56,670 | 48,498 | 42,716 | 18,403 | 230 | 166,517 |
| 1985 | D | 51,970 | 49,201 | 45,880 | 20,355 | 268 | 167,674 |
| 1990 | | 45,470 | 38,424 | 34,907 | 16,265 | 216 | 135,282 |

[a]Figures in this table obtained by summing the corresponding figures over the twenty faculties shown in Tables II-20 through II-39.

TABLE II-40/2

Full-Time Undergraduate Enrolment[a] in Provincially Supported Universities for the Province of Ontario Estimate 1-A/2

| Academic Year Beginning | | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
|---|---|---|---|---|---|---|---|
| 1961 | | 8,345 | 6,163 | 4,811 | 2,354 | 27 | 21,700 |
| 1962 | | 8,925 | 7,280 | 5,514 | 2,122 | 27 | 23,868 |
| 1963 | A | 11,154 | 8,218 | 6,620 | 2,427 | 26 | 28,445 |
| 1964 | C | 13,047 | 9,254 | 7,179 | 2,759 | 31 | 32,270 |
| 1965 | T | 15,997 | 11,047 | 8,150 | 3,134 | 27 | 38,355 |
| 1966 | U | 18,865 | 13,582 | 9,751 | 3,481 | 44 | 45,723 |
| 1967 | A | 21,269 | 16,800 | 12,112 | 4,009 | 38 | 54,228 |
| 1968 | L | 25,162 | 18,659 | 15,009 | 5,087 | 37 | 63,954 |
| 1969 | | 29,550 | 23,526 | 17,168 | 6,563 | 39 | 76,846 |
| 1970 | | 31,960 | 26,248 | 20,751 | 8,192 | 28 | 87,179 |
| 1971 | | 35,860 | 28,380 | 23,360 | 9,753 | 30 | 97,383 |
| 1972 | | 39,800 | 31,879 | 25,400 | 10,746 | 35 | 107,860 |
| 1973 | P | 42,450 | 35,422 | 28,691 | 11,430 | 40 | 118,033 |
| 1974 | R | 45,320 | 37,780 | 31,880 | 12,911 | 40 | 127,931 |
| 1975 | O | 47,180 | 40,335 | 34,002 | 14,346 | 40 | 135,903 |
| 1976 | J | 49,400 | 41,990 | 36,301 | 15,301 | 40 | 143,032 |
| 1977 | E | 51,800 | 43,966 | 37,791 | 16,335 | 40 | 149,932 |
| 1978 | C | 53,900 | 46,102 | 39,569 | 17,006 | 40 | 156,617 |
| 1979 | T | 56,000 | 47,971 | 41,492 | 17,806 | 40 | 163,308 |
| 1980 | E | 56,900 | 49,840 | 43,174 | 18,671 | 40 | 168,625 |
| 1985 | D | 52,200 | 50,552 | 46,298 | 20,690 | 40 | 170,780 |
| 1990 | | 45,700 | 39,516 | 35,324 | 16,112 | 40 | 136,692 |

[a]Figures in this table obtained by applying the survival method to the total of first year enrolment for the twenty faculties covered in Tables II-20 through II-39.

TABLE II-41

Actual and Projected Full-Time Undergraduate Enrolment[a] in Provincially Assisted Universities in Ontario Derived from Age Group 18-21

Estimate 1-B

| | Year Dec. 1 | 18-21 Age Group[b] | Undergraduate Enrolment | Enrolment as a % of 18-21 Age Group |
|---|---|---|---|---|
| ACTUAL | 1960 | 310,640 | 25,430 | 8.19 |
| | 1961 | 316,680 | 27,852 | 8.79 |
| | 1962 | 326,240 | 31,100 | 9.53 |
| | 1963 | 339,870 | 34,893 | 10.27 |
| | 1964 | 358,820 | 39,431 | 10.99 |
| | 1965 | 383,580 | 45,895 | 11.96 |
| | 1966 | 444,919 | 55,441 | 12.46 |
| | 1967 | 470,280 | 65,174 | 13.86 |
| | 1968 | 487,200 | 77,051 | 15.82 |
| | 1969 | 508,400 | 87,686 | 17.25 |
| | 1970 | 530,400 | 98,061 | 18.49 |
| PROJECTED | 1971 | 545,600 | 108,260 | 19.84 |
| | 1972 | 560,400 | 118,800 | 21.19 |
| | 1973 | 575,900 | 130,150 | 22.60 |
| | 1974 | 593,700 | 142,490 | 24.00 |
| | 1975 | 612,600 | 155,600 | 25.40 |
| | 1976 | 631,100 | 169,130 | 26.80 |
| | 1977 | 647,700 | 180,710 | 27.90 |
| | 1978 | 661,800 | 190,600 | 28.80 |
| | 1979 | 672,600 | 199,010 | 29.59 |
| | 1980 | 677,800 | 206,050 | 30.40 |
| | 1985 | 636,800 | 217,000 | 34.08 |
| | 1990 | 567,500 | 209,975 | 37.00 |

[a]Based on enrolments as reported by the Department of University Affairs.

[b]Department of Treasury and Economics.

TABLE II-42

Actual and Projected Total Full-Time Enrolment[a]
in Provincially Assisted Universities in Ontario
Derived from Age Group 18-24
Estimate 1-C

| | Year Dec. 1 | 18-24 Age Group[b] | Total Enrolment | Enrolment as a % of 18-24 Age Group |
|---|---|---|---|---|
| ACTUAL | | | | |
| | 1960 | 539,000 | 28,807 | 5.34 |
| | 1961 | 548,550 | 31,585 | 5.76 |
| | 1962 | 561,500 | 34,443 | 6.13 |
| | 1963 | 574,500 | 39,190 | 6.82 |
| | 1964 | 604,100 | 44,853 | 7.42 |
| | 1965 | 637,800 | 52,701 | 8.26 |
| | 1966 | 727,405 | 62,851 | 8.64 |
| | 1967 | 764,838 | 73,805 | 9.65 |
| | 1968 | 812,700 | 87,016 | 10.71 |
| | 1969 | 858,100 | 99,656 | 11.61 |
| | 1970 | 902,700 | 111,122 | 12.31 |
| PROJECTED | | | | |
| | 1971 | 934,800 | 123,030 | 13.16 |
| | 1972 | 963,500 | 135,340 | 14.04 |
| | 1973 | 989,600 | 148,520 | 15.00 |
| | 1974 | 1,016,500 | 162,820 | 16.01 |
| | 1975 | 1,044,500 | 178,020 | 17.04 |
| | 1976 | 1,073,500 | 193,790 | 18.05 |
| | 1977 | 1,102,800 | 207,310 | 18.80 |
| | 1978 | 1,131,200 | 219,100 | 19.37 |
| | 1979 | 1,156,600 | 229,010 | 19.80 |
| | 1980 | 1,175,300 | 237,050 | 20.17 |
| | 1985 | 1,169,900 | 250,000 | 21.37 |
| | 1990 | 1,043,500 | 242,975 | 23.28 |

[a] Based on enrolments as reported by Department of University Affairs.

[b] Department of Treasury and Economics.

v. <u>graduate enrolment as a percentage of total enrolment</u>:

Graduate enrolment was projected using total university enrolment as the base. The extrapolations of the ratio of graduate to total enrolment are based on the data for the past ten years. The results are presented in Table II-43, Estimate 1-D.

b. <u>Set 2 projections</u>: The University Affairs data used in Set 1 covers only provincially assisted universities. The DBS data used in Set 2 cover all universities in Ontario, but refer to different definitions of graduate and undergraduate studies.

In Set 2, undergraduate, graduate, and total enrolments are projected. The methodology is the same as that referred to above regarding Estimates 1-B, 1-C, and 1-D. The results are presented in Tables II-44, II-45, and II-46.

2. <u>Methods of projecting enrolment for the Colleges of Applied Arts and Technology</u>

Projecting enrolments for the Colleges of Applied Arts and Technology (CAATs) is more difficult than projecting the enrolments for the universities. The main reason for this is, quite simply, the newness of the CAATs. There is little history upon which to base trend analysis.

The projected enrolments for the CAATs to 1990 rely heavily upon the recent projections to 1981-82 by Cicely Watson,

TABLE II-43

Actual and Projected Full-Time Graduate Enrolment[a]

in Provincially Assisted Universities in Ontario

Estimate 1-D

| | Year Dec. 1 | Total Enrolment | Graduate Enrolment | Graduate Enrolment as a % of Total Enrolment |
|---|---|---|---|---|
| ACTUAL | 1960 | 28,807 | 3,377 | 11.72 |
| | 1961 | 31,585 | 3,733 | 11.82 |
| | 1962 | 34,443 | 3,343 | 9.71 |
| | 1963 | 39,190 | 4,297 | 10.96 |
| | 1964 | 44,852 | 5,421 | 12.09 |
| | 1965 | 52,701 | 6,806 | 12.91 |
| | 1966 | 62,851 | 7,410 | 11.79 |
| | 1967 | 73,805 | 8,631 | 11.69 |
| | 1968 | 87,016 | 9,965 | 11.45 |
| | 1969 | 99,656 | 11,970 | 12.01 |
| | 1970 | 111,122 | 13,061 | 11.75 |
| PROJECTED | 1971 | 123,030 | 14,770 | 12.00 |
| | 1972 | 135,340 | 16,540 | 12.22 |
| | 1973 | 148,520 | 18,370 | 12.37 |
| | 1974 | 162,824 | 20,330 | 12.49 |
| | 1975 | 178,020 | 22,420 | 12.59 |
| | 1976 | 192,790 | 24,660 | 12.73 |
| | 1977 | 207,310 | 26,600 | 12.83 |
| | 1978 | 219,100 | 28,500 | 13.01 |
| | 1979 | 229,010 | 30,000 | 13.01 |
| | 1980 | 237,050 | 31,000 | 13.01 |
| | 1985 | 250,000 | 33,000 | 13.20 |
| | 1990 | 242,975 | 33,000 | 13.58 |

[a]Based on enrolments as reported by the Department of University Affairs.

TABLE II-44

Actual and Projected Full-Time Undergraduate

Enrolment[a] in Ontario

Derived from Age Group 18-21

Estimate 2-B

| | Year | 18-21 Age Group[b] | Undergraduate Enrolment | Enrolment as a % of 18-21 Age Group |
|---|---|---|---|---|
| | 1960 | 310,640 | 29,501 | 9.50 |
| | 1961 | 316,680 | 32,968 | 10.41 |
| | 1962 | 326,240 | 35,941 | 11.02 |
| A | 1963 | 339.870 | 39,990 | 11.77 |
| C | 1964 | 358,820 | 45,369 | 12.64 |
| T | 1965 | 383,580 | 52,124 | 13.59 |
| U | 1966 | 444,919 | 60,862 | 13.68 |
| A | 1967 | 470,280 | 69,307 | 14.74 |
| L | 1968 | 487,200 | 81,091 | 16.64 |
| | 1969 | 508,400 | 94,554 | 18.60 |
| | 1970 | 530,400 | 106,668 | 20.11 |
| | 1971 | 545,600 | 118,050 | 21.64 |
| | 1972 | 560,400 | 129,800 | 23.16 |
| | 1973 | 575,900 | 142,100 | 24.67 |
| P | 1974 | 593,700 | 155,390 | 26.17 |
| R | 1975 | 612,600 | 164,500 | 26.85 |
| O | 1976 | 631,100 | 176,380 | 27.95 |
| J | 1977 | 647,700 | 186,740 | 28.83 |
| E | 1978 | 661,800 | 198,300 | 29.96 |
| C | 1979 | 672,600 | 207,530 | 30.85 |
| T | 1980 | 677,800 | 214,720 | 31.68 |
| E | | | | |
| D | 1981 | 685,364 | 219,860 | 32.08 |
| | 1986 | 614,649 | 225,820 | 36.74 |
| | 1990 | 562,414 | 214,570 | 38.15 |

[a]Based on enrolments as reported by D.B.S.

[b]Department of Treasury and Economics.

TABLE II-45

Actual and Projected Total Full-Time

Enrolment[a] in Ontario

Derived from Age Group 18-24

Estimate 2-C

| | Year | 18-24 Age Group[b] | Total Enrolment | Enrolment as a % of 18-24 Age Group |
|---|---|---|---|---|
| | 1960 | 539,000 | 32,100 | 5.96 |
| | 1961 | 548,550 | 35,871 | 6.54 |
| | 1962 | 561,500 | 39,269 | 6.99 |
| A | 1963 | 574,500 | 44,191 | 7.69 |
| C | 1964 | 604,100 | 50,793 | 8.41 |
| T | 1965 | 637,800 | 58,983 | 9.25 |
| U | 1966 | 727,405 | 68,589 | 9.43 |
| A | 1967 | 764,838 | 79,089 | 10.34 |
| L | 1968 | 812,700 | 92,589 | 11.39 |
| | 1969 | 858,100 | 108,012 | 12.59 |
| | 1970 | 902,700 | 121,227 | 13.43 |
| | 1971 | 934,800 | 134,453 | 14.38 |
| P | 1972 | 963,500 | 148,111 | 15.37 |
| R | 1973 | 989,600 | 162,428 | 16.41 |
| O | 1974 | 1,016,500 | 177,869 | 17.50 |
| J | 1975 | 1,044,500 | 188,477 | 18.04 |
| E | 1976 | 1,073,500 | 202,303 | 18.85 |
| C | 1977 | 1,102,800 | 214,369 | 19.44 |
| T | 1978 | 1,131,200 | 227,833 | 20.14 |
| E | 1979 | 1,156,600 | 238,595 | 20.63 |
| D | 1980 | 1,175,300 | 246,990 | 21.02 |
| | 1981 | 1,187,868 | 253,004 | 21.30 |
| | 1986 | 1,146,389 | 259,966 | 22.68 |
| | 1990 | 1,030,040 | 246,896 | 23.97 |

[a]Based on enrolments as reported by D.B.S.

[b]Department of Treasury and Economics.

TABLE II-46

Actual and Projected Full-Time Graduate

Enrolment[a] in Ontario

Estimate 2-D

| | Year | Total Enrolment | Graduate Enrolment | Graduate Enrolment as a % of Total Enrolment |
|---|---|---|---|---|
| | 1960 | 32,100 | 2,599 | 8.10 |
| | 1961 | 35,871 | 2,903 | 8.09 |
| | 1962 | 39,269 | 3,328 | 8.47 |
| | 1963 | 44,191 | 4,201 | 9.51 |
| A | 1964 | 50,793 | 5,424 | 10.68 |
| C | 1965 | 58,983 | 6,859 | 11.63 |
| T | 1966 | 68,589 | 7,727 | 11.27 |
| U | 1967 | 79,089 | 9,782 | 12.37 |
| A | 1968 | 92,589 | 11,498 | 12.42 |
| L | 1969 | 108,012 | 13,458 | 12.46 |
| | 1970 | 121,227 | 14,559 | 12.01 |
| | 1971 | 134,453 | 16,403 | 12.19 |
| | 1972 | 148,111 | 18,311 | 12.36 |
| P | 1973 | 162,428 | 20,328 | 12.52 |
| R | 1974 | 177,869 | 22,479 | 12.64 |
| O | 1975 | 188,477 | 23,977 | 12.72 |
| J | 1976 | 202,303 | 25,923 | 12.81 |
| E | 1977 | 214,369 | 27,629 | 12.89 |
| C | 1978 | 227,833 | 29,533 | 12.96 |
| T | 1979 | 238,595 | 31,065 | 13.02 |
| E | 1980 | 246,990 | 32,270 | 13.07 |
| D | | | | |
| | 1981 | 253,004 | 33,144 | 13.10 |
| | 1986 | 259,966 | 34,146 | 13.13 |
| | 1990 | 246,896 | 32,326 | 13.09 |

[a]Based on enrolments as reported by D.B.S.

Saeed Quazi, and Farid Siddiqui.[3] As in the Watson-Quazi-Siddiqui work, two sets of projections are produced here. The first is based upon estimates of student supplies emanating from separate sources: Grade 13, Grade 12, Ontario population over 22, other provinces, and other countries. The second is based upon estimates of future age group participation rates. The first year enrolment projections and the corresponding projections of total enrolment from the first set cover the years to 1981, and are presented in Tables II-47 and II-48. The projections from the second set, generally lower than their counterparts in the first set, cover the years through 1990, and are found in Tables II-49 and II-50.

3. Elementary school teacher projections

Because the institutional arrangements for the training of teachers in Ontario are in a state of flux, we have not attempted to project enrolment in teachers' colleges or in undergraduate teacher training programs. Instead, we have made projections for the demand for new teachers in Ontario. These projections are derived from a recent study by Watson, Quazi, and Jones.[4]

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[3] These tables may not be reproduced without permission from The Ontario Institute for Studies in Education until after the release of Ontario Colleges of Applied Arts and Technology, Enrollment Projections to 1981-82, by C. Watson, S. Quazi, and Farid Siddiqui (forthcoming).

[4] The Ontario Elementary School Teachers, A Study of Characteristics and Supply/Demand Relations, Cicely Watson, Saeed Quazi and Russell Jones (forthcoming 1972). This report was partially funded under contract with the Planning and Policy Analysis Unit of the Department of Education. To use these estimates before their publication requires permission from the Department of Education.

TABLE II-47

Full-Time First Year Enrolment in Colleges of Applied Arts and Technology by Source of Students

| | End of October Year | (1) Ontario Grade 12 Graduates | (2) Ontario Grade 13 Students (non-graduates included) | (3) Total of 1 and 2 | (4) Mature Students 22 Years and Over | (5) Canada Outside Ontario | (6) Foreign Students | (7) First Year Total |
|---|---|---|---|---|---|---|---|---|
| ACTUAL | 1967 | 5,816 | 1,396 | 7,212 | 889 | 66 | 82 | 8,249 |
| | | 80.6% | 19.4% | 100.0% | | | | |
| | | 70.5% | 16.9% | | 10.8% | 0.8% | 1.0% | 100.0% |
| | 1968 | 8,882 | 1,623 | 10,505 | 1,482 | 160 | 183 | 12,330 |
| | | 84.6 | 15.4 | 100.0 | | | | |
| | | 72.0 | 13.2 | | 12.0 | 1.3 | 1.5 | 100.0 |
| | 1969 | 10,548 | 1,661 | 12,210 | 1,913 | 274 | 320 | 14,717 |
| | | 86.4 | 13.6 | 100.0 | | | | |
| | | 71.7 | 11.3 | | 13.0 | 1.9 | 2.2 | 100.0 |
| PROJECTED | 1970 | 12,305 | 1,917 | 14,222 | 2,336 | 346 | 398 | 17,302 |
| | | 86.5 | 13.5 | 100.0 | | | | |
| | | 71.1 | 11.1 | | 13.5 | 2.0 | 2.3 | 100.0 |
| | 1971 | 14,584 | 2,360 | 16,944 | 2,862 | 435 | 498 | 20,739 |
| | | 86.1 | 13.9 | 100.0 | | | | |
| | | 70.3 | 11.4 | | 13.8 | 2.1 | 2.4 | 100.0 |
| | 1972 | 16,276 | 2,829 | 19,105 | 3,180 | 514 | 585 | 23,384 |
| | | 85.2 | 14.8 | 100.0 | | | | |
| | | 69.6 | 12.1 | | 13.6 | 2.2 | 2.5 | 100.0 |
| | 1973 | 18,079 | 3,250 | 21,329 | 3,498 | 600 | 679 | 26,106 |
| | | 84.8 | 15.2 | 100.0 | | | | |
| | | 69.3 | 12.4 | | 13.4 | 2.3 | 2.6 | 100.0 |

Source: Ontario Colleges of Applied Arts and Technology, Enrollment Projections to 1981-82, Cicely Watson, Saeed Quazi, and Farid Siddiqui (forthcoming).

Continued on next page

TABLE II-47 (Continued)

PROJECTED

| End of October Year | (1) Ontario Grade 12 Graduates | (2) Ontario Grade 13 Students (non-graduates included) | (3) Total of 1 and 2 | (4) Mature Students 22 Years and Over | (5) Canada Outside Ontario | (6) Foreign Students | (7) First Year Total |
|---|---|---|---|---|---|---|---|
| 1974 | 19,658 | 3,701 | 23,359 | 3,774 | 686 | 772 | 28,591 |
| | 84.2% | 15.8% | 100.0% | | | | |
| | 68.8% | 12.9% | | 13.2% | 2.4% | 2.7% | 100.0 |
| 1975 | 21,578 | 4,113 | 25,691 | 4,088 | 786 | 880 | 31,445 |
| | 84.0 | 16.0 | 100.0 | | | | |
| | 68.6 | 13.1 | | 13.0 | 2.5 | 2.8 | 100.0 |
| 1976 | 23,659 | 4,476 | 28,135 | 4,448 | 896 | 1,000 | 34,479 |
| | 84.1 | 15.9 | 100.0 | | | | |
| | 68.6 | 13.0 | | 12.9 | 2.6 | 2.9 | 100.0 |
| 1977 | 25,562 | 4,874 | 30,436 | 4,780 | 1,008 | 1,120 | 37,344 |
| | 84.0 | 16.0 | 100.0 | | | | |
| | 68.4 | 13.1 | | 12.8 | 2.7 | 3.0 | 100.0 |
| 1978 | 27,067 | 5,233 | 32,300 | 5,033 | 1,110 | 1,189 | 39,632 |
| | 83.8 | 16.2 | 100.0 | | | | |
| | 68.3 | 13.2 | | 12.7 | 2.8 | 3.0 | 100.0 |
| 1979 | 27,797 | 5,626 | 33,423 | 5,167 | 1,189 | 1,230 | 41,009 |
| | 83.2 | 16.8 | 100.0 | | | | |
| | 67.8 | 13.7 | | 12.6 | 2.9 | 3.0 | 100.0 |
| 1980 | 28,361 | 5,859 | 34,220 | 5,248 | 1,260 | 1,260 | 41,988 |
| | 82.9 | 17.1 | 100.0 | | | | |
| | 67.5 | 14.0 | | 12.5 | 3.0 | 3.0 | 100.0 |
| 1981 | 28,780 | 6,066 | 34,846 | 5,344 | 1,283 | 1,283 | 42,756 |
| | 82.6 | 17.4 | 100.0 | | | | |
| | 67.3 | 14.2 | | 12.5 | 3.0 | 3.0 | 100.0 |

Source: Ontario Colleges of Applied Arts and Technology, Enrollment Projections to 1981-82, Cicely Watson, Saeed Quazi, and Farid Siddiqui (forthcoming).

TABLE II-48

Colleges of Applied Arts and Technology

Full-Time Total Enrolment, Past and Projected

| | Year | First Year | Total |
|---|---|---|---|
| ACTUAL | 1967 | 8,249 | 11,219 |
| | 1968 | 12,330 | 19,112 |
| | 1969 | 14,717 | 24,430 |
| PROJECTED | 1970 | 17,302 | 30,452 |
| | 1971 | 20,739 | 37,745 |
| | 1972 | 23,384 | 43,494 |
| | 1973 | 26,106 | 48,818 |
| | 1974 | 28,591 | 52,751 |
| | 1975 | 31,445 | 59,117 |
| | 1976 | 34,479 | 65,165 |
| | 1977 | 37,344 | 70,580 |
| | 1978 | 39,632 | 74,904 |
| | 1979 | 41,009 | 77,507 |
| | 1980 | 41,988 | 79,357 |
| | 1981 | 42,756 | 80,809 |

Source: Ontario Colleges of Applied Arts and Technology, Enrollment Projections to 1981-82, Cicely Watson, Saeed Quazi, and Farid Siddiqui (forthcoming).

TABLE II-49

Colleges of Applied Arts and Technology

Full-Time First Year Enrolment as Percent of Age Group 18-21

| | Academic Year Beginning October | Enrolment | Age group 18-21 (in 000s) | Enrolment as % of age group 18-21 | Relative increase in participation rate of age group 18-21 1967 = 100.0 |
|---|---|---|---|---|---|
| ACTUAL | 1967 | 8,249 | 461.5 | 1.7874 | 100.00 |
| | 1968 | 12,330 | 487.2 | 2.5308 | 141.59 |
| | 1969 | 14,717 | 508.4 | 2.8947 | 161.95 |
| PROJECTED | 1970 | 16,970 | 530.4 | 3.1994 | 179.00 |
| | 1971 | 19,115 | 545.6 | 3.5033 | 196.00 |
| | 1972 | 21,245 | 560.4 | 3.7893 | 212.00 |
| | 1973 | 23,365 | 575.9 | 4.0574 | 227.00 |
| | 1974 | 25,575 | 593.7 | 4.3076 | 241.00 |
| | 1975 | 27,810 | 612.6 | 4.5400 | 254.00 |
| | 1976 | 30,060 | 631.1 | 4.7634 | 266.5 |
| | 1977 | 32,300 | 647.7 | 4.968 | 279.00 |
| | 1978 | 34,480 | 661.8 | 5.2103 | 291.50 |
| | 1979 | 36,545 | 672.6 | 5.4337 | 304.00 |
| | 1980 | 38,345 | 677.8 | 5.6571 | 316.50 |
| | 1985 | 42,569 | 636.8 | 6.6849 | 374.0 |
| | 1990 | 43,009 | 567.5 | 7.5786 | 424.0 |

Source: Population figures from Department of Treasury and Economics.
Enrolment figures from Ontario Colleges of Applied Arts and Technology, Enrollment Projections to 1981-82, Cicely Watson, Saeed Quazi, and Farid Siddiqui (forthcoming).

TABLE II-50

Colleges of Applied Arts and Technology

Full-Time Total Enrolment as a Percent of Age Group 18-21

| | Academic Year Beginning | Enrolment | Age group 18-21 (in 1000) | Enrolment as % of age group 18-21 | Relative increase in participation rate of age group 18-21 1967 = 100.0 |
|---|---|---|---|---|---|
| ACTUAL | 1967 | 11,266 | 461.5 | 2.4225 | 100.00 |
| | 1968 | 19,040 | 487.2 | 3.9124 | 161.5 |
| | 1969 | 24,421 | 508.4 | 4.8035 | 198.23 |
| PROJECTED | 1970 | 30,708 | 530.4 | 5.7896 | 238.99 |
| | 1971 | 34,629 | 545.6 | 6.3470 | 262.00 |
| | 1972 | 38,962 | 560.4 | 6.9526 | 287.00 |
| | 1973 | 43,109 | 575.9 | 7.4855 | 309.00 |
| | 1974 | 47,318 | 593.7 | 7.9700 | 329.00 |
| | 1975 | 51,718 | 612.6 | 8.4424 | 348.5 |
| | 1976 | 56,185 | 631.1 | 8.9027 | 367.5 |
| | 1977 | 60,566 | 647.7 | 9.3509 | 386.0 |
| | 1978 | 64,850 | 661.8 | 9.7990 | 404.5 |
| | 1979 | 68,983 | 672.6 | 10.2472 | 423.0 |
| | 1980 | 72,493 | 677.8 | 10.6953 | 441.5 |
| | 1985 | 82,378 | 636.8 | 12.9362 | 534.0 |
| | 1990 | 86,129 | 567.5 | 15.1770 | 626.5 |

Source: <u>Ontario Colleges of Applied Arts and Technology, Enrollment Projections to 1981-82</u>, Cicely Watson, Saeed Quazi, and Farid Siddiqui (forthcoming).

Alternative projections were made corresponding to three different assumptions about future trends in pupil/teacher ratios. Estimate (1) assumes no change in the pupil/teacher ratio from that of the 1970-71 level; Estimate (2) and Estimate (3) assume two different target pupil/teacher ratios expected to be achieved by 1980; 22.0 and 21.0 respectively. In both estimates, it is assumed that the pupil/teacher ratio will be constant after 1980 (Table II-51).

In view of the present mood of the public of Ontario regarding educational expenditures, and of current economic conditions, it seems unlikely that the pupil/teacher ratio will change in the next few years. It is probable, however, that both economic conditions and attitudes toward school expenditures will change in a few years (in Estimate 1-A, a "few years" becomes three years). Then pupil/teacher ratios will again decrease, producing the same results as Estimate 2 before the end of this decade. Though it may seem a capricious choice, Estimate 1-A is in fact our "best guess" regarding these developments.

Table II-52 indicates the potential mix of different sources of supply. In the past, supply came from qualified teachers migrating to Ontario and from new graduates of the Ontario Teacher Colleges. In view of the shortage of teaching jobs in Ontario and the higher qualifications now required for these jobs, it seems likely that immigration will become a less

TABLE II-51

Projected Number of Teachers in Elementary Schools in Ontario 1971-1990

Using Four Alternative Assumptions Regarding Pupil/Teacher Ratios

| | Year | Enrolment K-8 | Estimate 1 | | Estimate 2 | | Estimate 3 | | Estimate 1A | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Teachers | Pupil/ Teacher Ratio | Teachers | Pupil/ Teacher Ratio | Teachers | Pupil/ Teacher Ratio | Teachers | Pupil/ Teacher Ratio |
| ACTUAL | 1969 | 1,437,746 | 56,800 | 25.3 | | | | | | |
| | 1970 | 1,446,154 | 58,500 | 24.7 | | | | | | |
| PROJECTED | 1971 | 1,448,994 | 58,662 | 24.7 | 58,617 | 24.7 | 58,901 | 24.6 | 58,662 | 24.7 |
| | 1972 | 1,436,550 | 58,159 | 24.7 | 58,734 | 24.6 | 59,302 | 24.2 | 58,159 | 24.7 |
| | 1973 | 1,416,146 | 57,333 | 24.7 | 58,851 | 24.1 | 59,703 | 23.7 | 57,333 | 24.7 |
| | 1974 | 1,392,538 | 56,377 | 24.7 | 58,968 | 23.6 | 60,104 | 23.2 | 57,071 | 24.4 |
| | 1975 | 1,368,566 | 55,406 | 24.7 | 59,085 | 23.2 | 60,505 | 22.6 | 57,023 | 24.0 |
| | 1976 | 1,347,612 | 54,558 | 24.7 | 59,201 | 22.8 | 60,906 | 22.1 | 57,102 | 23.6 |
| | 1977 | 1,332,789 | 53,958 | 24.7 | 59,317 | 22.5 | 61,307 | 21.7 | 57,447 | 23.2 |
| | 1978 | 1,319,430 | 53,417 | 24.7 | 59,433 | 22.2 | 61,707 | 21.4 | 57,869 | 22.8 |
| | 1979 | 1,312,659 | 53,143 | 24.7 | 59,549 | 22.0 | 62,107 | 21.1 | 58,600 | 22.4 |
| | 1980 | 1,312,659 | 53,143 | 24.7 | 59,666 | 22.0 | 62,507 | 21.0 | 59,666 | 22.0 |
| | 1985 | 1,312,659 | 53,436 | 24.7 | 59,994 | 22.0 | 62,851 | 21.0 | 59,994 | 22.0 |
| | 1990 | 1,487,150 | 60,207 | 24.7 | 67,597 | 22.0 | 70,816 | 21.0 | 67,597 | 22.0 |

Source: The Ontario Elementary School Teachers, A Study of Characteristics and Supply/Demand Relations, Cicely Watson, Saeed Quazi, and Russell Jones (forthcoming).

important source of teachers for Ontario. In this event, new supplies will come mostly or entirely from the graduates of the teachers' colleges and faculties of education. Estimates of expansion demand are based on increases or decreases in the number of elementary school students in Ontario. Replacement demand is based on past and present trends in attrition, which have been quite stable. The estimates of re-entries to the profession are also based on past and present trends.

The figures in Table II-52 indicate that, in the future, demand for new teachers will be mainly due to replacement demand. If the traditionally large number of teachers leaving the profession is reduced, then the demand for new teachers will, of course, contract. As more university qualified teachers come into the profession, it is likely that the number and percentage of those leaving the profession will indeed be reduced considerably. Table II-52 depicts the plausible phenomenon of a decrease in the demand for new elementary teachers until 1973 (to 5,318), followed by a gradual increase to 1980.

4. Secondary school teachers projection

Three projections of the demand for new teachers are presented here. The projections for 1970-81 are taken from

TABLE II-52

Projected Demand for New Elementary School Teachers in Ontario

| | Year | (1) Stock of Teachers | (2) Expansion Demand | (3) Replacement Demand | (4) Re-entries to Profession | (5) Demand for New Teachers[a] |
|---|---|---|---|---|---|---|
| ACTUAL | 1969 | 56,800 | | | | |
| | 1970 | 58,500 | | | | |
| PROJECTED | 1971 | 58,662 | 162 | 8,775 | 2,640 | 6,297 |
| | 1972 | 58,159 | -403 | 8,799 | 2,617 | 5,779 |
| | 1973 | 57,333 | -826 | 8,724 | 2,580 | 5,318 |
| | 1974 | 57,666 | -262 | 8,600 | 2,568 | 5,770 |
| | 1975 | 57,999 | -48 | 8,561 | 2,566 | 5,947 |
| | 1976 | 58,333 | 79 | 8,553 | 2,570 | 6,062 |
| | 1977 | 58,666 | 345 | 8,565 | 2,585 | 6,325 |
| | 1978 | 58,999 | 422 | 8,617 | 2,604 | 6,435 |
| | 1979 | 59,333 | 731 | 8,680 | 2,637 | 6,774 |
| | 1980 | 59,666 | 1,066 | 8,790 | 2,685 | 7,171 |
| | 1985 | 59,994 | 60 | 8,990 | 2,700 | 6,350 |
| | 1990 | 67,597 | 1,520 | 9,912 | 3,042 | 8,390 |

Source: *The Ontario Elementary School Teachers, A Study of Characteristics and Supply/Demand Relations*, Cicely Watson Saeed Quazi and Russell Jones (forthcoming).

[a]Numbers in column 5 equal those in column 2 plus column 3, minus column 4.

a recent study by Watson and Quazi.[5] Those projections are extended here to 1985 and 1990. The results are shown in Tables II-53 and II-54.

Estimate 1 assumes a constant student/teacher ratio at the 1970 rate. Estimate 2 assumes an increase in the student/teacher ratio to 17.9 by 1975, a steady decline to 15.7 by 1985, and constancy to 1990. Estimate 3 assumes the student/teacher ratio to increase to 17.1 in 1974, to decline to 14.5 by 1985, and then to stabilize.

With the great number of children born in the late fifties or early sixties still to enter the high schools, any reduction in the student/teacher ratio seems improbable for quite a few years. Estimate 1-A assumes the conditions of Estimate 1 to prevail until 1975, then a belated movement to the path depicted by Estimate 3. It seems a likely candidate for "most probable" course of events.

5. A note on Grade 13 and enrolment projections

Table II-55 is included simply to preclude any confusion that might arise due to the fact that enrolment projections in most jurisdictions on this continent typically are based upon

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[5] The Ontario Secondary School Teacher, A Study of Characteristics and Supply/Demand Relations, Cicely Watson and Saeed Quazi (forthcoming). This report was partially funded under contract with the Planning and Policy Analysis Unit of the Department of Education. Permission from the Department is required before further publication of the figures given here.

TABLE II-53

Projected Number of Teachers in Public Secondary Schools in Ontario 1971-1990

| Year | Sec. School Enrolment | Estimate 1 | | Estimate 2 | | Estimate 3 | | Estimate 1A | |
|---|---|---|---|---|---|---|---|---|---|
| | | Teachers | Student/ Teacher Ratio | Teachers | Student/ Teacher Ratio | Teachers | Student/ Teacher Ratio | Teachers | Student/ Teacher Ratio |
| 1970[1] | 556,913 | 33,693 | 16.5 | | | | | | |
| 1971 | 580,568 | 35,186 | 16.5 | 34,378 | 16.9 | 34,694 | 16.7 | 35,186 | 16.5 |
| 1972 | 603,206 | 36,558 | 16.5 | 35,063 | 17.2 | 35,695 | 16.9 | 36,558 | 16.5 |
| 1973 | 624,474 | 37,847 | 16.5 | 35,748 | 17.5 | 36,696 | 17.0 | 37,847 | 16.5 |
| 1974 | 646,014 | 39,152 | 16.5 | 36,433 | 17.7 | 37,697 | 17.1 | 39,152 | 16.5 |
| 1975 | 663,497 | 40,212 | 16.5 | 37,118 | 17.9 | 38,698 | 17.1 | 40,212 | 16.5 |
| 1976 | 675,306 | 40,928 | 16.5 | 37,803 | 17.9 | 39,699 | 17.0 | 40,928 | 16.5 |
| 1977 | 681,109 | 41,279 | 16.5 | 38,488 | 17.7 | 40,700 | 16.7 | 41,279 | 16.5 |
| 1978 | 683,390 | 41,418 | 16.5 | 39,174 | 17.4 | 41,701 | 16.4 | 41,701 | 16.4 |
| 1979 | 682,304 | 41,352 | 16.5 | 39,859 | 17.1 | 42,702 | 16.0 | 42,702 | 16.0 |
| 1980 | 668,518 | 40,516 | 16.5 | 40,544 | 16.5 | 43,703 | 15.3 | 43,703 | 15.3 |
| 1985 | 575,400 | 34,873 | 16.5 | 36,650 | 15.7 | 39,682 | 14.5 | 39,682 | 14.5 |
| 1990 | 577,900 | 35,024 | 16.5 | 36,809 | 15.7 | 39,855 | 14.5 | 39,855 | 14.5 |

Source: The Ontario Secondary School Teachers, A Study of Characteristics and Supply/Demand Relations, Cicely Watson and Saeed Quazi (forthcoming).

(1) Actual figures.

TABLE II-54

Projected Demand for Teachers in Public Secondary Schools in Ontario 1970-1990

| Year | (1) Stock of Teachers | (2) Expansion Demand | (3) Replacement Demand | (4) Re-entries to Profession | (5) Demand for New Teachers[a] |
|---|---|---|---|---|---|
| 1970 | 33,693 | | | | |
| 1971 | 35,186 | 1,493 | 3,875 | 809 | 4,559 |
| 1972 | 36,558 | 1,372 | 4,046 | 841 | 4,577 |
| 1973 | 37,847 | 929 | 4,202 | 870 | 4,263 |
| 1974 | 39,152 | 1,305 | 4,352 | 900 | 4,757 |
| 1975 | 40,212 | 1,060 | 4,502 | 925 | 4,637 |
| 1976 | 40,928 | 716 | 4,624 | 941 | 4,399 |
| 1977 | 41,279 | 351 | 4,707 | 949 | 4,109 |
| 1978 | 41,701 | 422 | 4,747 | 959 | 4,210 |
| 1979 | 42,702 | 1,001 | 4,796 | 982 | 4,815 |
| 1980 | 43,703 | 1,001 | 4,911 | 1,005 | 4,907 |
| 1985 | 39,682 | -800 | 4,646 | 913 | 2,933 |
| 1990 | 39,855 | 40 | 4,577 | 917 | 3,700 |

Source: The Ontario Secondary School Teachers, A Study of Characteristics and Supply/Demand Relations, Cicely Watson, Saeed Quazi (forthcoming).

[a]Numbers in column 5 equal those in column 2 plus column 3, minus column 4.

TABLE II-55

Ratio of First Year Full-Time Undergraduate Enrolment in Provincially Assisted Universities to 18-Year-Old and 19-Year-Old Population in Ontario

| | Year | 1st Year Full-time Undergrad. Enrolment | Population Age 18 | Population Age 19 | 1st year Undergraduate Enrolment as a % of Population Age 18 | 1st year Undergraduate Enrolment as a % of Population Age 19 |
|---|---|---|---|---|---|---|
| ACTUAL | 1961 | 8,345 | 81,706 | 79,959 | 10.21 | 10.44 |
| | 1962 | 8,925 | | | | |
| | 1963 | 11,154 | Data not available | | | |
| | 1964 | 13,184 | | | | |
| | 1965 | 15,997 | | | | |
| | 1966 | 19,088 | 119,690 | 122,662 | 15.95 | 15.56 |
| | 1967 | 21,269 | Data not available | | | |
| | 1968 | 25,129 | | | | |
| | 1969 | 29,570 | 130.6 | 128.3 | 22.64 | 23.05 |
| | 1970 | 31,986 | 135.2 | 133.3 | 23.66 | 24.00 |
| PROJECTED | 1971 | 35,862 | 139.2 | 136.8 | 25.76 | 26.21 |
| | 1972 | 39,795 | 143.7 | 140.6 | 27.69 | 28.30 |
| | 1973 | 42,447 | 148.7 | 144.8 | 28.54 | 29.31 |
| | 1974 | 45,390 | 153.8 | 149.8 | 29.51 | 30.30 |
| | 1975 | 47,179 | 158.4 | 155.0 | 29.78 | 30.44 |
| | 1976 | 49,372 | 162.2 | 159.5 | 30.44 | 30.95 |
| | 1977 | 51,804 | 165.3 | 163.3 | 31.34 | 31.72 |
| | 1978 | 53,860 | 167.8 | 166.5 | 32.10 | 32.35 |
| | 1979 | 56,031 | 169.3 | 168.9 | 33.10 | 33.17 |
| | 1980 | 56,898 | 167.3 | 170.5 | 34.01 | 33.37 |
| | 1985 | 52,169 | 149.8 | 153.2 | 34.83 | 34.05 |
| | 1990 | 45,743 | 135.0 | 138.9 | 33.88 | 32.93 |

cohorts of eighteen-year-olds, while it is more appropriate to use nineteen-year-olds in Ontario. This is, of course, due to the established institution that is Grade 13 in this province.

The projections in this table indicate that using either the eighteen-year-old cohort or the nineteen-year-old cohort furnishes almost the same results over the period under consideration. First year enrolment was 10.21 per cent and 10.44 per cent of eighteen-year-olds and nineteen-year-olds respectively in 1961. It was 23.66 per cent and 24.00 per cent in 1970. It is expected to be 34.01 per cent and 33.37 per cent in 1980, and 33.8 per cent and 32.93 per cent in 1990. This statement, of course, should not be interpreted as an implication that policy on Grade 13 will, or will not, have important effects upon participation in post-secondary education in Ontario.

## E. Conclusions

### 1. University

The accuracy of a projection depends upon the quality and quantity of data available and the continuation of past trends. In view of the comments we have made in Part C about the University Affairs data regarding faculties, the degree of accuracy expected in the projections will vary from one faculty to another. For those faculties which have had stable growth (as mentioned before, generally those which are con-

centrated at one or two universities), and whose trends are clear, projections may be considered quite reliable. For some faculties, projection results must be offered with many <u>caveats</u>. For others, any considerable effort at producing projections of enrolments is difficult to justify.

According to Estimates 1-C and 2-C (Tables II-42 and II-45), the expected total university enrolment will be 237,050 or 246,990 by 1980. According to Estimates 1-B and 2-B (Tables II-41 and II-44), the expected undergraduate enrolment will reach 206,050 or 214,720 by 1980. These estimates include enrolment at existing and future undergraduate faculties of education, but exclude enrolment at teachers' colleges. According to Estimates 1-D and 2-D (Tables II-43 and II-46), the expected graduate enrolment will reach 31,000 or 32,270 by 1980.

Estimates after 1981 should be seen as a direction of growth only. In particular, the validity of the estimates based on Grade 13 over a long period should be treated cautiously because of the doubtful future of Grade 13. In view of the relative merits of the data and the stability of trends, we consider estimates based on the participation rate method to be more reliable, that is Estimates 1-B and 2-B are regarded as more reliable than 1-A for undergraduate enrolment projections.

Considering relative merits of the DBS and DUA data, we are inclined to favour the estimates based on DBS data. Thus, we

regard 2-B, 2-C and 2-D as being more reliable than 1-B, 1-C, and 1-D.

While Projection 2-D in Table II-46 is our "best guess" about graduate enrolment, it must be admitted that graduate enrolment is particularly hazardous to forecast. It is far from certain that the conditions which contributed to the expansion of graduate enrolment during the 1960s will characterize the next decade. Significant changes in these conditions will make the extrapolation of past trends misleading. Two of the most important of these conditions are employment opportunities for people with graduate degrees and public policy for the funding of graduate students.

Employment prospects for people with graduate degrees are currently less promising than they were during the period of rapid expansion of graduate enrolment in the 1960s. It is less certain whether the depressed market for graduate degree holders is mainly a reflection of the general economic situation or an indication of a structural disequilibrium that may persist for some years. As has been discussed in Chapter III of Part A, there has been little research on the effect of the job market upon students' enrolment decisions. Thus it may be said that not only are there uncertainties about the market for graduate degree holders, but also about the effect of job prospects upon the demand for places in graduate school. It is not implausible, however, to suppose that the feedback

from the market will result in a significant retardation of the growth of graduate enrolment.

A second factor which may retard the growth of graduate enrolment is the raising of graduate tuition and/or reducing the availability of funding, particularly research support. Changes in funding are not easy to predict, but suggestions about shifting a larger share of the cost of education to the students are beginning to be heard more frequently.[6] Such changes seem more likely to occur at the graduate than undergraduate level. Moreover, there is evidence that graduate students are more responsive to changes in price than are undergraduates. M. L. Handa (forthcoming) has estimated that the price elasticity of enrolment demand in Ontario during the 1950-65 period was several times greater for graduate students than for undergraduates. Presumably, graduate students are also more sensitive to employment prospects than undergraduates, since graduate education is almost entirely oriented to vocational preparation and graduates are one step closer to entering the labour market than are undergraduates.

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[6] The Economic Council of Canada stated that "some curtailment of public expenditure on higher education might be accomplished without any significant adverse effects on the quantity and quality of higher education by reversing the trend towards a declining proportion of expenditure covered by student fees." (Seventh Annual Review, 1970: 70). The Council goes on to speak of "arrangements for replacing some public financing with larger private financing." The Council warns, however, that such arrangements should be devised so that young persons with the ability and motivation for higher education are not prevented by financial barriers from pursuing higher education.

To say that graduate enrolment is very much dependent upon funding is to say that the size of future post-secondary enrolments is determined in large part by the future behaviour of educational policy-makers. Predicting that behaviour is difficult. The projections in Table II-46 are based on the assumption that there will be no significant changes in the behaviour of policy-makers, or in the other factors which have influenced graduate enrolment. To take into account possible changes in policy and other influencing factors, alternative sets of projections of graduate and total enrolment are presented in Tables II-56 and II-57. These are labelled as "Alternatives to 2-D".

The projections of graduate enrolment made in Table II-46 above are given in column (3) of Table II-56, and as a percentage of total enrolment in column (6) of Table II-57. These are the projections based on DBS data which have been designated as our "best guess" estimates. The alternative projections of graduate enrolment are given in the fourth and fifth columns of Table II-56 and are expressed as percentages of total enrolment in the seventh and eighth columns of Table II-57. One alternative is obtained by assuming that the graduate percentage remains roughly constant at about 12 per cent of total enrolment, rather than rising to 13 per cent as in the "best guess" projection. The constant percentage assumption leads to a projection of slightly under 30,000 for

TABLE II-56

Actual and Projected Full-Time University Enrolment in Ontario[a]

Alternatives to Projection 2-D

| Year | Full-Time Enrolment in Provincially Assisted Universities | | |
|---|---|---|---|
| | Undergraduate[b] | Graduate | Total |
| 1 | 2 | 3 | 4 |
| 1960 | 29,501 | 2,599 | 32,100 |
| 1961 | 32,968 | 2,903 | 35,871 |
| 1962 | 35,941 | 3,328 | 39,269 |
| 1963 | 39,990 | 4,201 | 44,191 |
| 1964 | 45,369 | 5,424 | 50,793 |
| 1965 | 52,124 | 6,859 | 58,983 |
| 1966 | 60,862 | 7,727 | 68,589 |
| 1967 | 69,307 | 9,782 | 79,089 |
| 1968 | 81,091 | 11,498 | 92,589 |
| 1969 | 94,554 | 13,458 | 108,012 |
| 1970 | 106,668 | 14,559 | 121,227 |

[a]Based on enrolments as reported by D.B.S.

[b]Projection 2-B taken from Table II-44.

Continued on next page

TABLE II-56 (Continued)[a]

Full-Time Enrolment in Provincially Assisted Universities

| Year | Undergraduate[b] | Graduate | | | Total | | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | | | 4 | | |
| | | Est. 1[c] | Est. 2 | Est. 3 | Est. 1[d] | Est. 2 | Est. 3 |
| 1971 | 118,050 | 16,403 | 16,116 | 14,600 | 134,453 | 134,166 | 132,650 |
| 1972 | 129,800 | 18,311 | 17,740 | 14,600 | 148,111 | 147,540 | 144,400 |
| 1973 | 142,100 | 20,328 | 19,444 | 14,600 | 162,428 | 161,544 | 156,700 |
| 1974 | 155,390 | 22,479 | 21,286 | 14,600 | 177,869 | 176,676 | 169,990 |
| 1975 | 164,500 | 23,977 | 22,560 | 14,600 | 188,477 | 187,060 | 179,100 |
| 1976 | 176,380 | 25,923 | 24,216 | 14,600 | 202,303 | 200,596 | 190,980 |
| 1977 | 186,740 | 27,629 | 25,668 | 14,600 | 214,369 | 212,408 | 201,340 |
| 1978 | 198,300 | 29,533 | 27,288 | 14,600 | 227,833 | 225,588 | 212,900 |
| 1979 | 207,530 | 31,065 | 28,591 | 14,600 | 238,595 | 236,121 | 222,130 |
| 1980 | 214,720 | 32,270 | 29,616 | 14,600 | 246,990 | 244,336 | 229,320 |
| 1981 | 219,860 | 33,144 | 30,360 | 14,600 | 253,004 | 250,220 | 234,460 |
| 1986 | 225,820 | 34,146 | 31,632 | 14,600 | 259,966 | 257,452 | 240,420 |
| 1991 | 214,570 | 32,326 | 29,664 | 14,600 | 246,896 | 244,234 | 229,170 |

[a] Based on enrolment as reported by D.B.S.
[b] Projection 2-B taken from Table II-44.
[c] Projection 2-D taken from Table II-46.
[d] Projection 2-C taken from Table II-45.

TABLE II-57

Actual and Projected Full-Time University Enrolment in Ontario Expressed as Percentages[a] Alternatives to Projection 2-D

| Year | Undergraduate[b] | Graduate | | Total |
|---|---|---|---|---|
| | as a % of 18-21 | as a % of undergraduate | as a % of Total | as a % of 18-24 Age Group |
| 1 | 2 | 3 | 4 | 5 |
| 1960 | 9.50 | 8.81 | 8.10 | 5.96 |
| 1961 | 10.41 | 8.81 | 8.09 | 6.54 |
| 1962 | 11.02 | 9.26 | 8.47 | 6.99 |
| 1963 | 11.77 | 10.51 | 9.51 | 7.69 |
| 1964 | 12.64 | 11.96 | 9.36 | 8.41 |
| 1965 | 13.59 | 13.16 | 11.63 | 9.25 |
| 1966 | 13.68 | 12.70 | 11.27 | 9.43 |
| 1967 | 14.74 | 14.11 | 12.37 | 10.34 |
| 1968 | 16.64 | 14.18 | 12.42 | 11.39 |
| 1969 | 18.60 | 14.23 | 12.46 | 12.59 |
| 1970 | 20.11 | 13.65 | 12.01 | 13.43 |

[a]Based on enrolments as reported by D.B.S.

[b]Projection 2-B taken from Table II-44.

Continued on next page

TABLE II-57 (Continued)[a]

| Year | Undergraduate[b] | Graduate | | | | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | as a % of 18-21 | as a % of Undergraduate | | | as a % of Total Enrolment | | | as a % of 18-24 Age Group | | |
| 1 | 2 | 3 | | | 4 | | | 5 | | |
| | | Est. 1 | Est. 2 | Est. 3 | Est. 1[c] | Est. 2 | Est. 3 | Est. 1[d] | Est. 2 | Est. 3 |
| 1971 | 21.64 | 13.89 | 13.65 | 12.37 | 12.19 | 12.01 | 11.01 | 14.38 | 14.35 | 14.19 |
| 1972 | 23.16 | 14.11 | 13.67 | 11.25 | 12.36 | 12.02 | 10.11 | 15.37 | 15.31 | 14.99 |
| 1973 | 24.67 | 14.31 | 13.68 | 10.27 | 12.52 | 12.04 | 9.32 | 16.41 | 16.32 | 15.83 |
| 1974 | 26.17 | 14.47 | 13.70 | 9.40 | 12.64 | 12.05 | 8.59 | 17.50 | 17.38 | 16.72 |
| 1975 | 26.85 | 14.58 | 13.71 | 8.88 | 12.72 | 12.06 | 8.15 | 18.04 | 17.91 | 17.15 |
| 1976 | 27.95 | 14.70 | 13.73 | 8.28 | 12.81 | 12.07 | 7.64 | 18.85 | 18.69 | 17.79 |
| 1977 | 28.83 | 14.80 | 13.75 | 7.82 | 12.89 | 12.08 | 7.25 | 19.44 | 19.26 | 18.26 |
| 1978 | 29.96 | 14.89 | 13.76 | 7.36 | 12.96 | 12.10 | 6.86 | 20.14 | 19.94 | 18.82 |
| 1979 | 30.85 | 14.97 | 13.78 | 7.04 | 13.02 | 12.11 | 6.57 | 20.63 | 20.42 | 19.21 |
| 1980 | 31.68 | 15.03 | 13.79 | 6.80 | 13.07 | 12.12 | 6.37 | 21.02 | 20.79 | 19.51 |
| 1981 | 32.08 | 15.08 | 13.81 | 6.64 | 13.10 | 12.13 | 6.23 | 21.30 | 21.06 | 19.74 |
| 1986 | 36.74 | 15.12 | 14.01 | 6.47 | 13.13 | 12.29 | 6.07 | 22.68 | 22.46 | 20.97 |
| 1991 | 38.15 | 15.07 | 13.82 | 6.80 | 13.09 | 12.15 | 6.37 | 23.97 | 23.71 | 22.25 |

[a]Based on enrolments as reported by D.B.S.

[b]Projection 2-B taken from Table II-44.

[c]Projection 2-D taken from Table II-46.

[d]Projection 2-C taken from Table II-45.

1991, compared to just over 32,000 for the basic projection. A more pessimistic projection is that total enrolment will remain at the 1970 absolute level--14,600. This implies a decrease to about 6 per cent in the graduate percentage of total enrolment.

The alternative projections of total enrolment corresponding to the alternative projections of graduate enrolment are shown in the last two columns of Table II-56. These are obtained by adding the alternative projection of graduate enrolment to the basic projection of undergraduate enrolment, given in column (2) of Table II-56. Since graduate enrolment is a relatively small component of total enrolment, large variations in projections of the former involve only relatively small variations in projections of the latter. The pessimistic projection of graduate enrolment is less than half of Projection 2-D, yet the corresponding total enrolment projection implies a participation rate of 22.5 per cent, compared to 23.97 per cent for Projection 2-D.

To say that a constant absolute number of graduate students will likely have no important effect upon the total number of university students is not to say that it will have no important effects upon the style of life in this province, of course, both on and off the campuses. The predictions of those effects are beyond the scope of this report. It is appropriate to mention, however, that such a constraint might initiate a

period of greater competition among university students, with concomitant interesting implications for the behaviour of students and professors. Beyond any doubt, under conditions of series of cohorts of increasing size for a long time to come, there would be imposed a decreasing level of post-graduate educational attainment for each successive cohort.

2. Colleges of Applied Arts and Technology

Four estimates are being presented in Tables II-47 through II-50. They were made on two different bases, as discussed in Section D. We are inclined to favour the first two estimates (Tables II-47 and II-48) for the period up to 1981 and the latter two for the period after 1981.

The estimates presented in the above tables exclude enrolment in Ryerson Polytechnical Institute and nursing schools and are based on the assumption that the future role of the CAAT will remain the same as at present, mainly to provide terminal post-secondary education.

3. Elementary school teachers

We have presented in Table II-51 four estimates of the number of teachers required by Ontario elementary schools to 1990, based on four probable pupil/teacher ratios. Having indicated preference for the assumption that pupil/teacher ratios will begin a gradual decline only after 1973, the estimates of the demand for new teachers each year are as in Table II-52. The size of a student body

in faculties of education that would be required to produce this annual supply of new teachers has not been estimated.

4. Secondary school teachers

Table II-53 presents four projected estimates of the need for secondary school teachers, based on four probable pupil/teacher ratios. Here it is assumed there will be no reduction of student/teacher ratios before 1975. The required new teachers for very modest (and perhaps irregular) expansion and for replacement will constitute an annual demand as estimated in Table II-54. As in the case of elementary school teachers, no estimates of the number of students enrolled in faculties of education required to produce this annual supply of teachers have been made. Moreover, no corrections have been made on the basis of assumptions as to whether Ontario will or will not, in the future, be a net importer of secondary school teachers.

# CHAPTER III

## SUMMARY OF PART B

Part B is divided into two chapters. The first chapter contains projections of requirements of highly qualified manpower in Ontario to 1990. The second chapter contains projections of enrolment in post-secondary education in Ontario to 1990.

The main purpose of the chapter on manpower requirements projections is to illustrate in detail the methodology for making projections, pointing out along the way the diffi-

culties posed by lack of data and by poor understanding of the processes of substitution among different types of manpower. The inadequacy of the data used in this part of the study should be underscored. In the authors' opinion, the poor quality of the data on which these and other manpower requirements projections are based makes any attempt to derive policy recommendations solely from manpower projections a rather foolish undertaking. To avoid even the appearance of this, the authors eschew any comparisons between the requirements projections in Chapter I and the enrolment projections in Chapter II.

Chapter I begins with a discussion of alternative definitions of "highly qualified manpower". The operational definition of the Canada Department of Manpower and Immigration is selected, i.e. persons employed in professional and technical occupations for which a university degree is usually necessary. Manpower requirements are projected for this group of occupations. The Manpower and Immigration definition of highly qualified manpower, and hence this projection exercise, excludes occupations for which the typical training is in the Colleges of Applied Arts and Technology. Unfortunately, there is not sufficient data to do projections for this important set of occupations.

Selected data on highly qualified manpower in Ontario are

examined. Most of the data on such characteristics as age, sex, citizenship, location, education, etc. is from the 1967 Survey of Highly Qualified Manpower conducted by the Canada Department of Manpower and Immigration. Following the examination of data on highly qualified manpower, there is an overview of the methodology used in projecting future manpower requirements. For reasons discussed in the overview, so far as is possible the occupational co-efficient method is used in making the projections. Projections of required manpower inflows are made for 42 industries under 24 different combinations of assumptions about the rate of growth of output, stability of occupational co-efficients, appropriate level of sectoral aggregation, and attrition. Comparison among the 24 sets of projections gives some evidence of the sensitivity of projections to variations in the underlying assumptions.

The manpower requirements projections are highly sensitive to the assumed rate of growth of output. A difference of one-half per cent in the growth of annual output is associated with a difference of more than ten per cent in the required manpower inflow during the period projected. The differences between projections based on 1961 occupational co-efficients and those based on projected occupational co-efficients vary across occupations, being small for some occupations and large for others. The projections are not sensitive to the degree of aggregation, variation in the required manpower inflows between

the aggregate projection and the sub-sector projections being about 0.2 per cent.

The enrolment projections in Chapter II are for the universities, Colleges of Applied Arts and Technology, and teachers' colleges. These institutions make up about three-quarters of post-secondary enrolment in Ontario. Omitted are nursing schools, colleges of agriculture, registered private schools, and Ryerson Polytechnical Institute.

The enrolment projections are preceded by a survey of projection methods and recent studies. The most widely used method is the age group participation rate, e.g. projecting university enrolment as a proportion of the population aged 18-24. Recently, there has been much interest in flow models. In such models, one must first project the transition proportions, e.g. second year enrolment in year t as a proportion of first year enrolment in year t-1. Since data on actual flows is not available, one must estimate transition proportions indirectly, comparing the stocks in different years. The transition proportions that have been estimated in this way show considerable instability over time, which raises some questions about the reliability of the data. Thus, though enrolment projections using transition proportions are reported here, it is suggested that the alternative set of projections using the participation rate method are more reliable.

The flow model projections use enrolment data from the

Ontario Department of University Affairs and from individual universities. Alternative sets of projections based on the participation rate method are made, using University Affairs data in one, and DBS data in the other. Of these three sets of projections, the participation rate method applied to DBS data is thought to be the most reliable.

The authors consider the best projection to be that undergraduate enrolments will increase from 106.7 thousand in 1970 (as reported by DBS) to 214.7 thousand in 1980. Enrolment as a proportion of the 18-21 age group is projected to rise from 9.5 per cent and 20.1 per cent in 1960 and 1970, respectively, to 31.7 per cent in 1980.

Graduate enrolment is a particularly hazardous phenomenon to project. Graduate as a proportion of total enrolment rose from 8 per cent to 12 per cent during the 1960s. As a "best guess", it is projected as rising to 13 per cent by 1980 and levelling off at that proportion of total enrolment.

Other assumptions about graduate enrolment are perhaps as realistic as this. A conservative but defensible assumption is that graduate enrolment in absolute numbers may be held to some approximation of what it now is. Projections of the total graduate and undergraduate enrolments assuming graduate enrolment fixed at 14,600 (actual graduate enrolment in 1970 was 14,559) are presented along with a brief comment on the implications for competition among university students of such a ceiling.

A full-time enrolment in the Colleges of Applied Arts and Technology is projected using several different assumptions about participation rate. An increase from 24,000 students in 1969 to 79,000 in 1980 is suggested as "most probable".

In the case of all the enrolment projections, it is emphasized that the size of future post-secondary enrolments is determined in large part by the future behaviour of educational policy-makers. The prediction of that behaviour is as difficult as it is immodest. Alternative sets of projections, therefore, should be regarded as statements of the results to be expected from feasible policy decisions rather than predictions of that policy or the limits of policy options.

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